NEI 16-03

Pre-application Meeting

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July 7, 2021

NUCLEAR ENERGY INSTITUTE

Meeting Objective

- Review NEI 16-03 background and proposed revisions
- Present Industrywide Learning Aging Management Program (i-LAMP) developments to date
- Present Pilot plant case studies
- Implementation path for i-LAMP

NEI 16-03 & i-LAMP Background

2016-2017

- NRC issued Generic Letter 2016-01 in April 2016
- Required US utility response
- NEI 16-03, Neutron Absorber Monitoring Guidance, submitted to the NRC in August 2016 and approved in May 2017

2018

- Requests for Additional Information (RAIs)
- NRC Public meetings, generic responses by US utilities based on EPRI reports (Impact of Blister/Pit on Reactivity & Roadmap for i-LAMP)
- Completion of review issued by NRC: November 27, 2018
- Close-out of GL: December 17, 2018

2019-2021

- SFP historic coupon report collection and analysis (global)
- SFP water chemistry data collection and analysis (global)
- Panel removal from an operating SFP and additional EPRI analysis
- Development of sister pool criteria and identification of pilot plants
- Regulatory review of i-LAMP

NEI 16-03, Revision 0

History

- Initially part of NEI 12-16, Criticality Guidance document
- Per NRC request, separated and submitted to the NRC as stand-alone guidance on **August 30, 2016** (**ML16265A248**)
- Safety Evaluation Report was received on **March 3, 2017** (**ML16354A486**)
- NEI 16-03-**A** was submitted to the NRC on **May 6, 2017** (**ML17263A133**)

NEI 16-03 offer the following approaches:

A neutron absorber monitoring program may rely on a combination of the following approaches:

1. *Installation of a neutron absorber coupon tree with periodic removal and testing of neutron absorber coupons;*
2. *In-situ measurements of the neutron absorbing capability of the installed neutron absorber panels,*
3. *Spent fuel pool water chemistry monitoring.*

Alternative approaches are also acceptable if adequately justified. *A monitoring program consists of identifying original material characteristics and testing, awareness of ongoing research and development, participation in industry groups that share operating experience amongst plants, and evaluation of the relevance of outside data on the in-service material. Acceptance criteria provide the basis for the comparison of results in order to determine whether material performance is acceptable or actions are necessary to address performance issues.*

NRC response (ML17263A133):

The staff determined that an appropriate ***combination of the three methods*** *listed above (coupon testing, in-situ measurement, and/or SFP water chemistry monitoring) can comprise an effective NAM monitoring program.*

Proposed Revision to NEI 16-03

NEI 16-03, Revision 0

1. Installation of a neutron absorber coupon tree with periodic removal and testing of neutron absorber coupons;
2. In-situ measurements of the neutron absorbing capability of the installed neutron absorber panels,
3. Spent fuel pool water chemistry monitoring*.

*SFP water chemistry stand alone is not approved as alternate monitoring approach. Accepted with combination of 1 and 2.

NEI 16-03, Revision 1 - Proposed

1. Installation of a neutron absorber coupon tree with periodic removal and testing of neutron absorber coupons;
2. i-LAMP, with referral to supplemental EPRI report
3. In-situ measurements of the neutron absorbing capability of the installed neutron absorber panels.

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Industrywide Learning Aging Management Program (i-LAMP)

Hatice Akkurt
Technical Executive

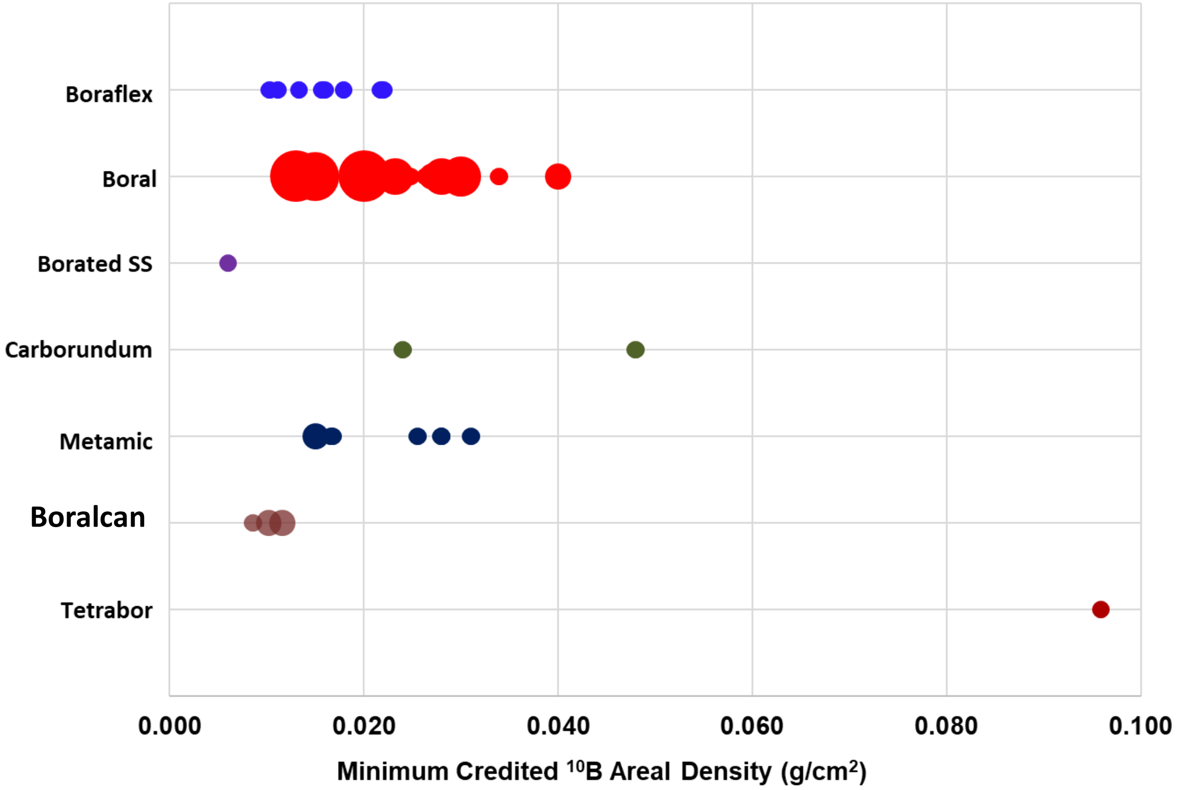
NRC Pre-application Meeting
July 7, 2021

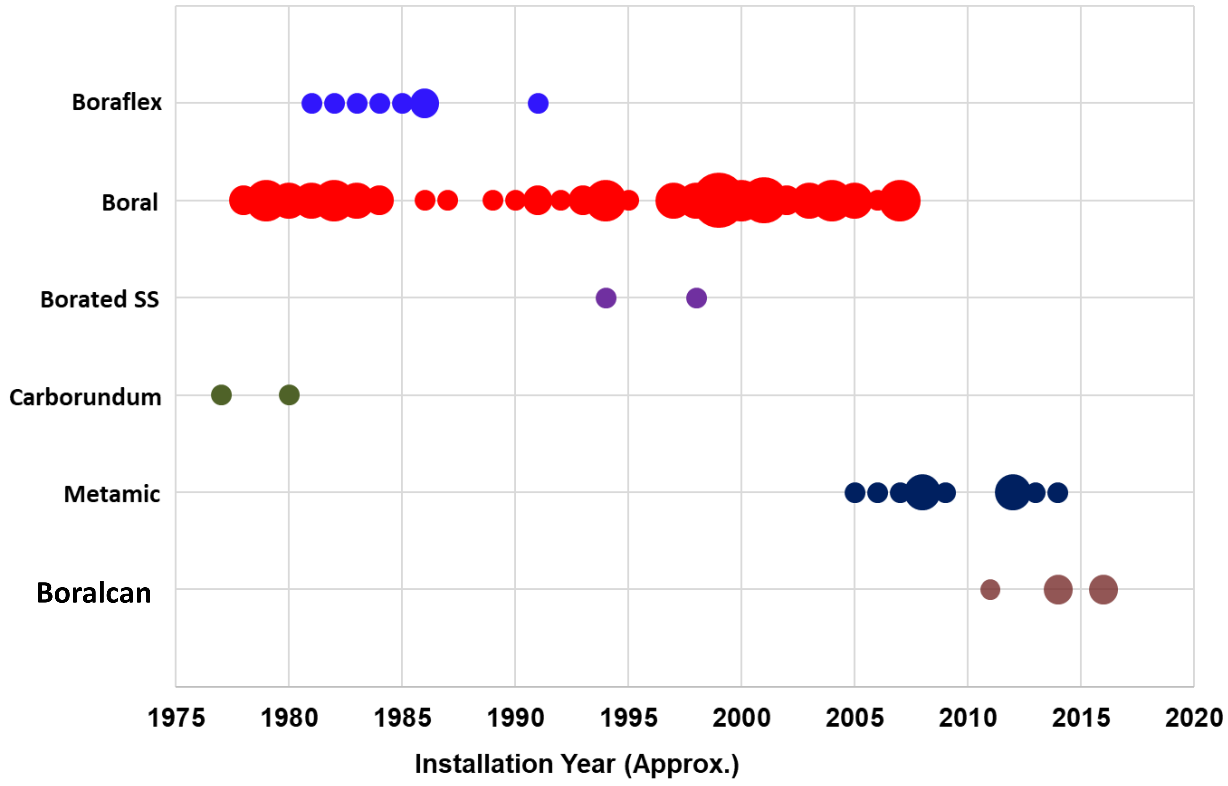
www.epri.com

Presentation Outline

- U.S. Neutron Absorber Material (NAM) Status Based on Generic Letter (GL) Responses
  - Review the NAM status (US)
- i-LAMP Overview & Analysis for Sibling Pool Determination
  - Review the concept
- Augmentation of i-LAMP via Addition of Panels from an Operating SFP
  - Describe panels with unique history
- Augmentation of i-LAMP Using Updated NAM Status & Non-US Data
  - Describe recent enhancements
- Pilot SFPs as Case Studies
  - Describe how to use i-LAMP
- Summary & Proposed Path and Schedule
  - Discuss what’s needed for implementation

Neutron Absorber Material (NAM) Status*





*US, based on Generic Letter responses

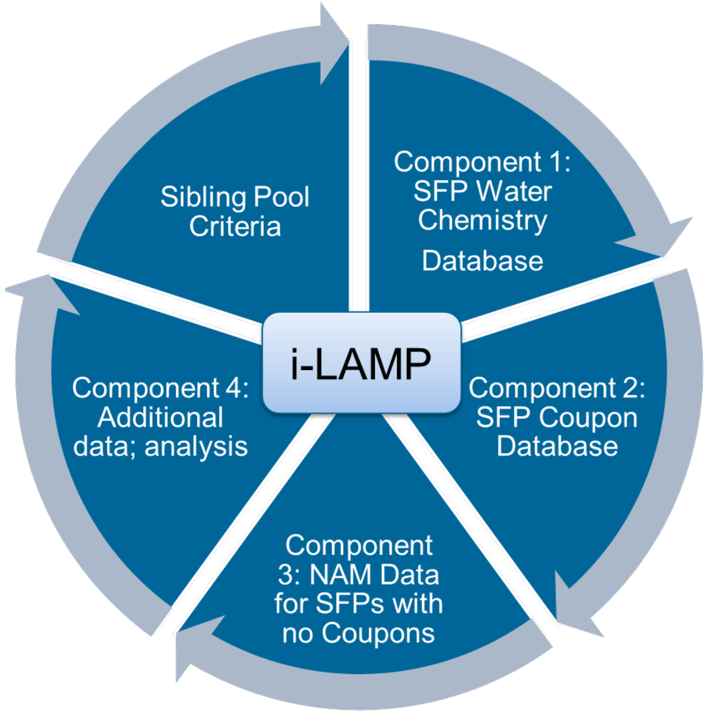
- Boraflex, Carborundum, and Tetrabor are not part of proposed industrywide monitoring program
- Boral is the only neutron absorber material, among remaining NAMs, without coupons for some of the SFPs

i-LAMP and Analysis for Sibling Pool Determination

i-LAMP: Industrywide Learning Aging Management Program

Why i-LAMP?

1. About half of the SFPs in the U.S. do not have a coupon monitoring program
2. License renewal requires commitment for aging management program
3. In situ measurements are expensive and may not be reliable – can indicate false degradation as demonstrated by Zion project
4. Alternative inspection (i.e., panel removal): Not only significant cost but also potentially significant dose for workers as well as risks for damaging panels



A Global Approach:

1. Given SFPs are very similar, can we develop an industrywide program that allows SFPs for which there is no coupon monitoring program to use SFPs with coupons as surrogate?
2. If similarities are demonstrated with the supporting data, potential benefits of such an approach will also include
    1. Coordination of measurements
    2. Easier identification of trends and potential issues

For i-LAMP to be successful, need to maintain remaining coupon population. Recommended:

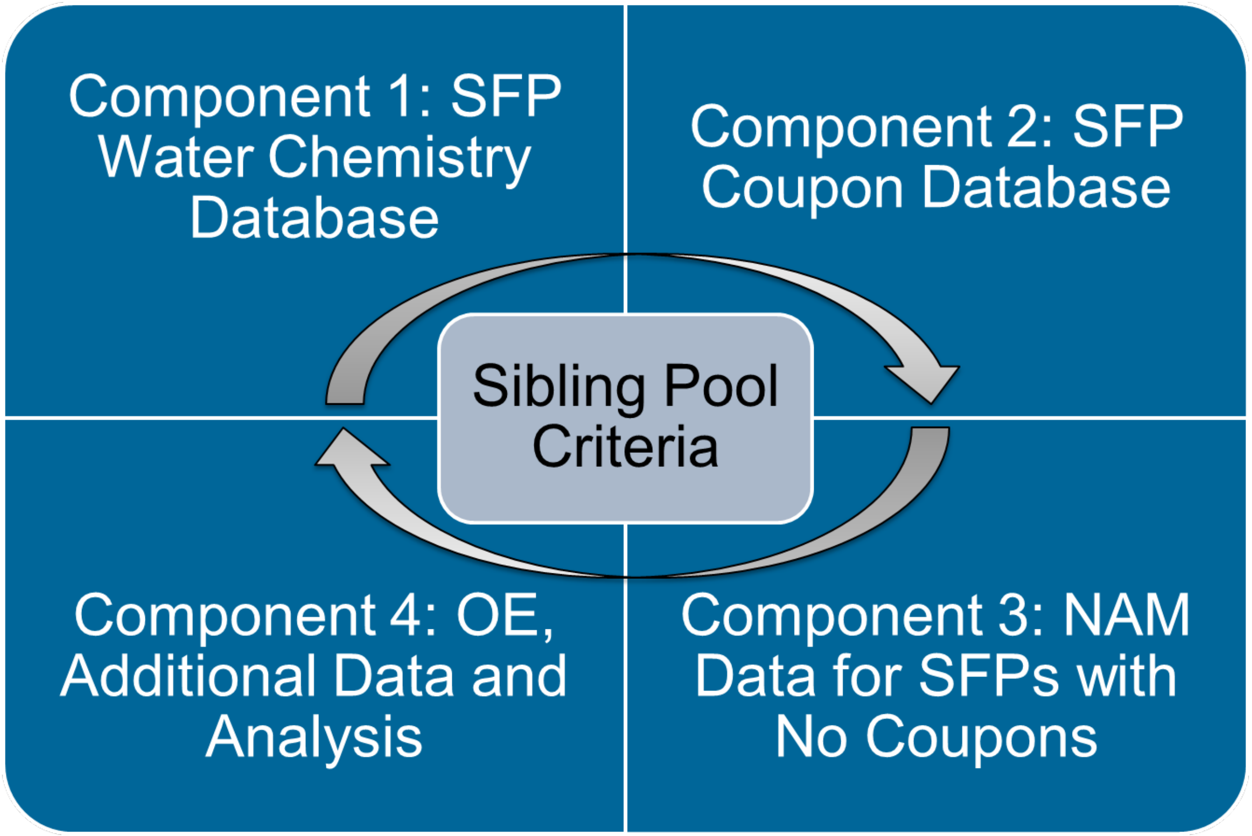
1. **Re-insertion of coupons after analysis (instead of discarding them) after Zion comparative analysis project and implemented by the industry**
2. **For early shutdowns, transfer coupons (if any) to a pool with similar characteristics**

Sibling Pool Criteria (SPC)

Potential Variables:

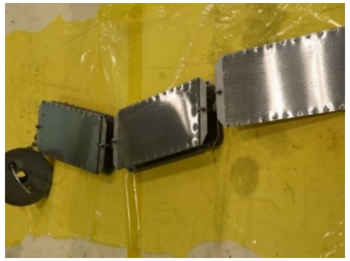
- Water Chemistry – from Component 1
  - B levels (PWR); Cl, F, SO4, Silica levels
- NAM Specification – from Component 2
  - Age, service time, specifications (areal density, thickness)
- NAM Specification – from Component 3
  - Age, service time, specifications (areal density, thickness)
- Additional analysis for similarity/impact determination
  - If there are differences (i.e., service time, water chemistry) evaluate the impact

Analysis performed to evaluate how characterization/binning should be done

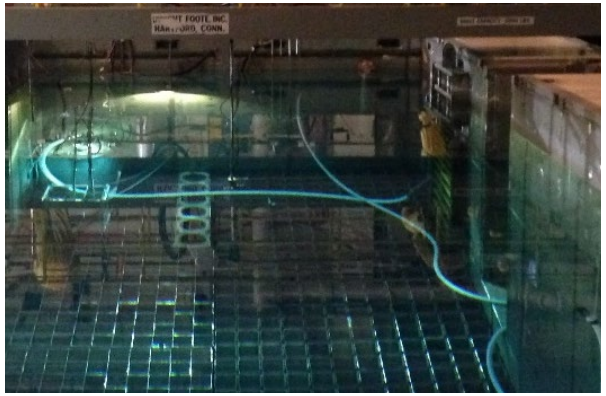


As part of learning aging management, binning will be revisited and revised as needed

Toward Determination of Sibling Pools



Similarity Analysis to Determine Sibling Pool(s)



SFPs without Coupons

SFPs with Coupons

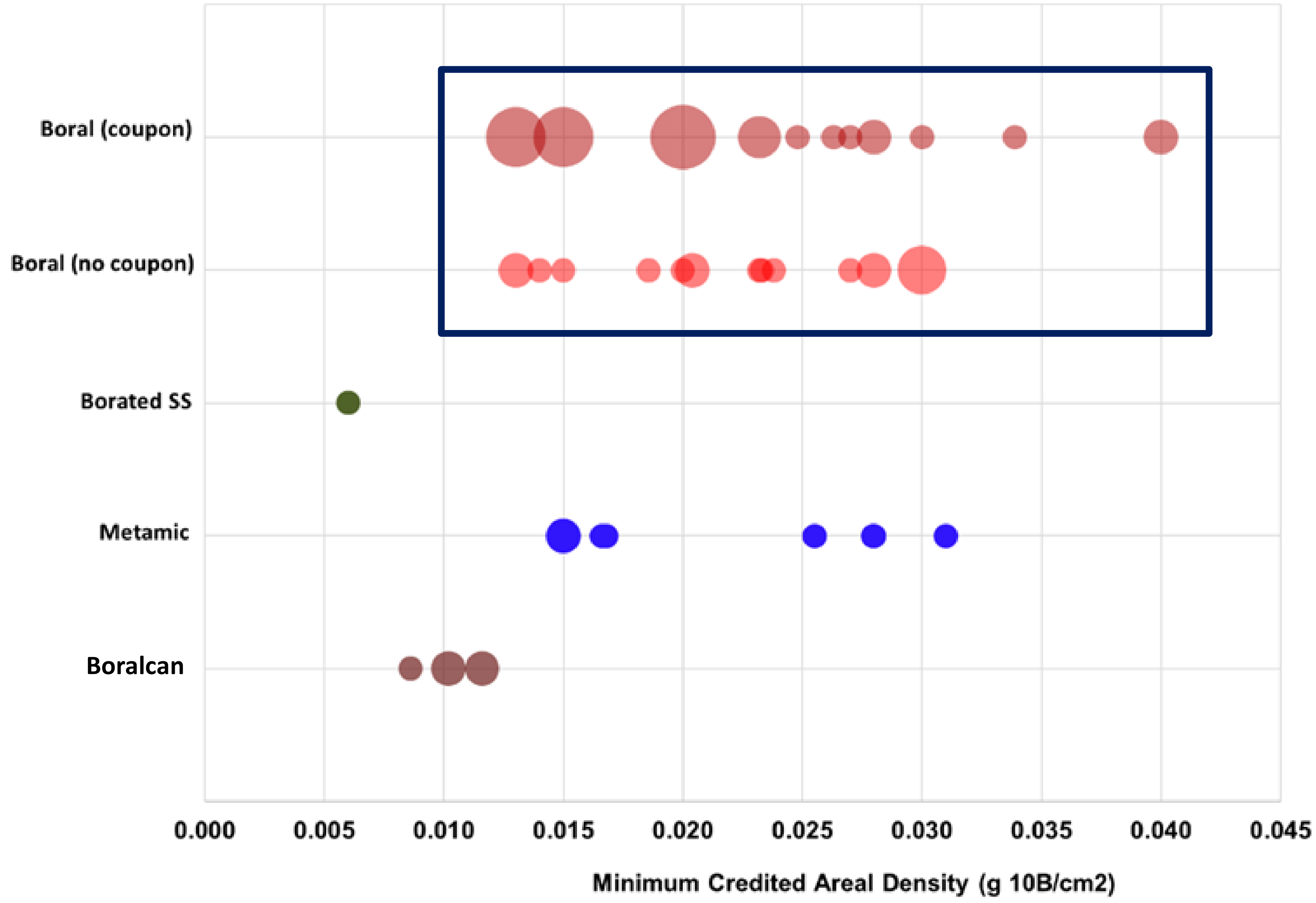
Important Questions:

1. How similar are the NAMs in SFPs?
2. How similar is the water chemistry between SFPs?
3. Are there outliers that are not bounded?
   - If yes, potential approaches to address outliers?

I. **How similar are the NAM characteristics?**
   1. ^{10}B Areal density
      - Thickness
   2. Installation year(s)
   3. Manufacturing year(s)

II. **How similar is the water chemistry?**
   1. Boron levels
   2. Cl, F, Sulfate levels
   3. Other chemistry parameters (Silica levels, pH, etc.)

SFP Neutron Absorber Material (NAM) Status: Areal Density (AD)



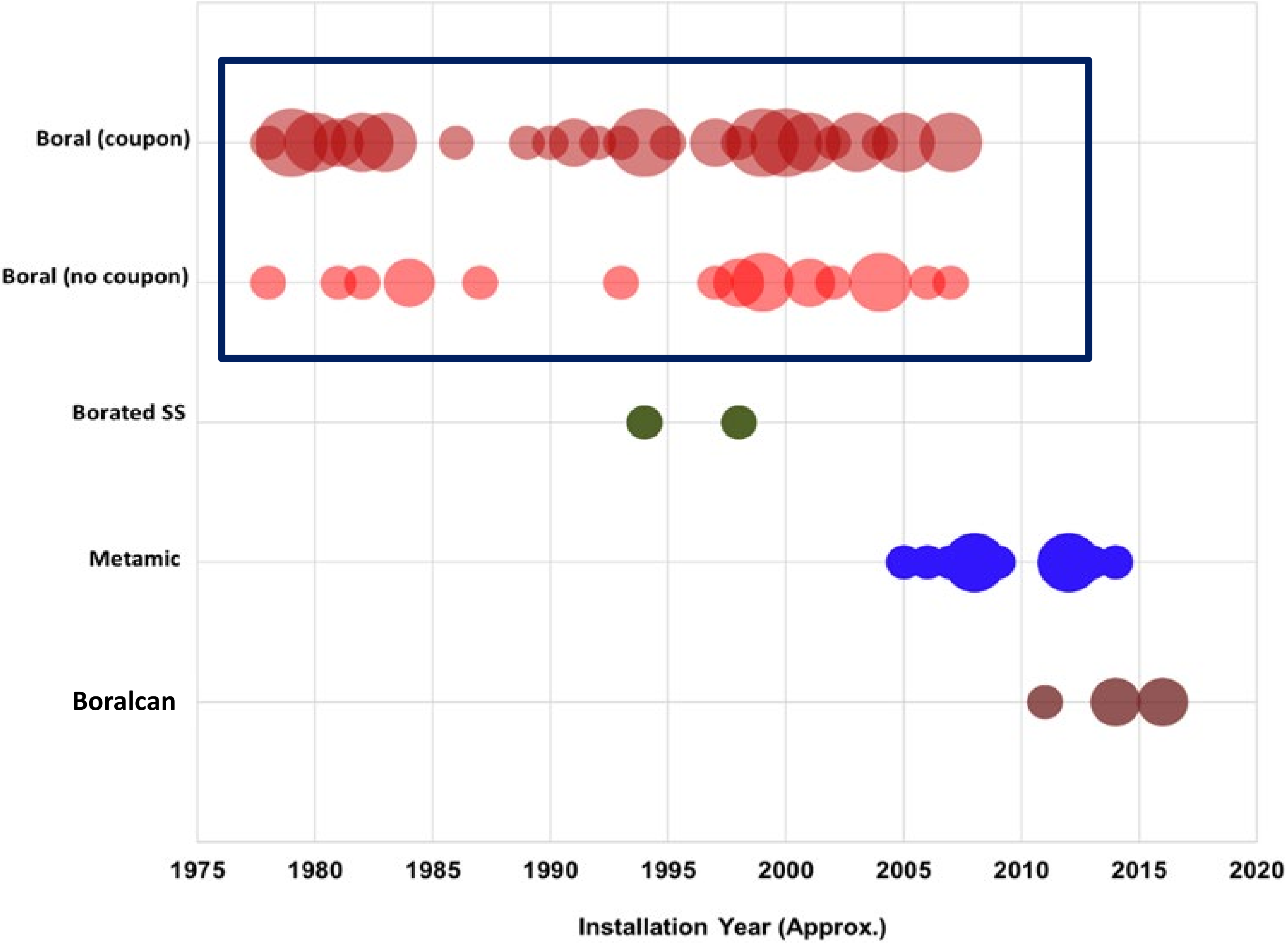
Boral:

1. 24 SFPs out of 57 SFPs in US do not have coupon monitoring program
2. Some SFPs have multiple NAMs
3. Some SFPs with Boral have multiple installation dates (same AD) and/or varying AD

Ideal case

Areal Density: **For Boral, all SFPs without coupons are bounded by SFPs with coupons**

SFP Neutron Absorber Material (NAM) Status: NAM Age

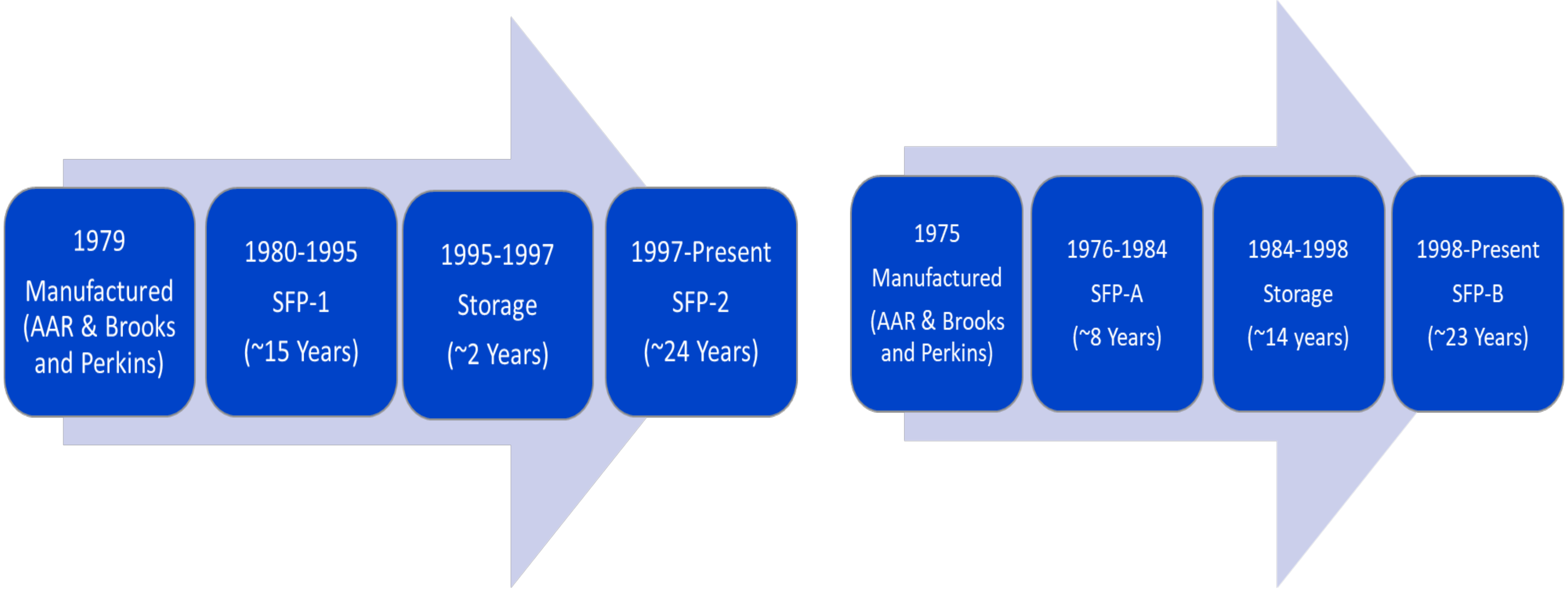


<u>Boral:</u>
For SFPs, **<u>installation</u>** and **<u>manufacturing</u>** year are similar with **<u>two exceptions</u>** due to their unique history

If not ideal case, additional analysis (or alternative solution) is needed

<u>NAM Age:</u> Not all but majority of SFPs without coupons are bounded – due to histories of two SFPs that are considered exceptions

Two SFPs with Unique Histories: Outliers for Significant Differences in Manufacturing and Installation Date & Panel Histories



- For both outliers, panels resided in two different SFPs (SFP-1 → SFP-2, SFP-A → SFP-B)
- Transportation and varying storage time in between two SFPs (Wet-Dry-Wet)
- Based on GL responses, in 2018 neither SFP-2 nor SFP-B had a coupon monitoring program

Augmentation of i-LAMP via Addition of Panels with Unique History from an Operating SFP

Evaluation of Panels from an Operating SFP (SFP-2 from slide 10)

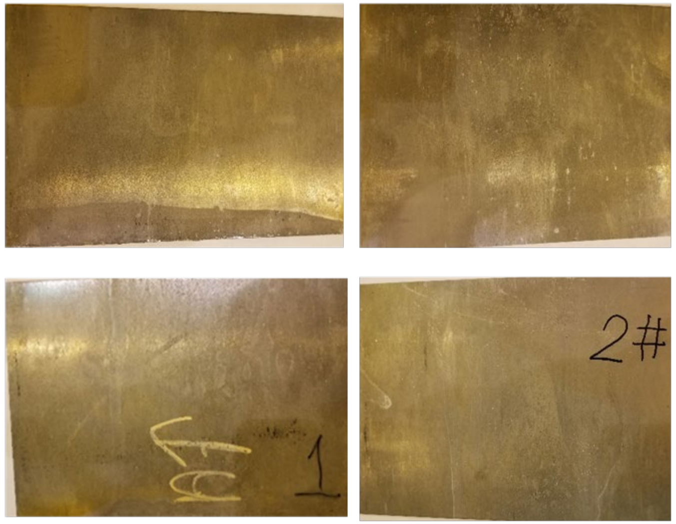
- 1979 Manufactured (AAR & Brooks and Perkins)
- 1980-1995 SFP-1 (~15 Years)
- 1995-1997 Storage (~2 Years)
- 1997-2019 SFP-2 (~22 Years)

These panels are <u>unique</u>:

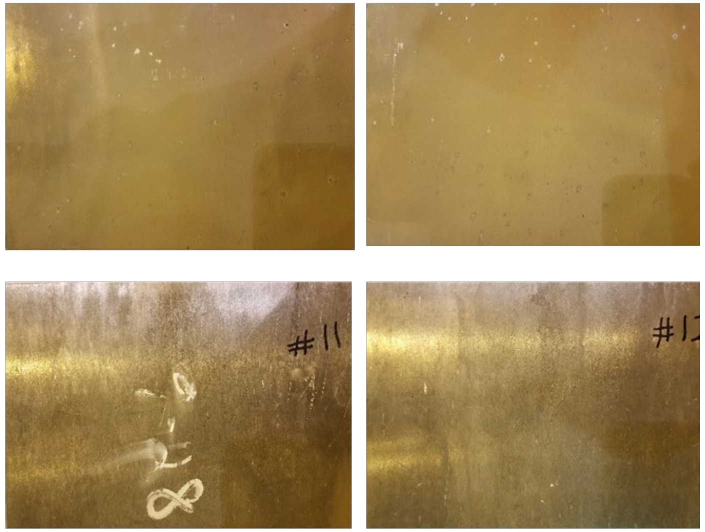
1. Age and vintage (considered most susceptible for blistering)
2. Used in two SFPs
3. Storage time in between two pools (dry)
4. Long service time (~40 years)

- Two panels removed from SFP-2
- Cut into coupon sizes
  - 22 equal size coupon/panel
  - Top sample (Sample 23) short and damaged for both panels – discarded top section

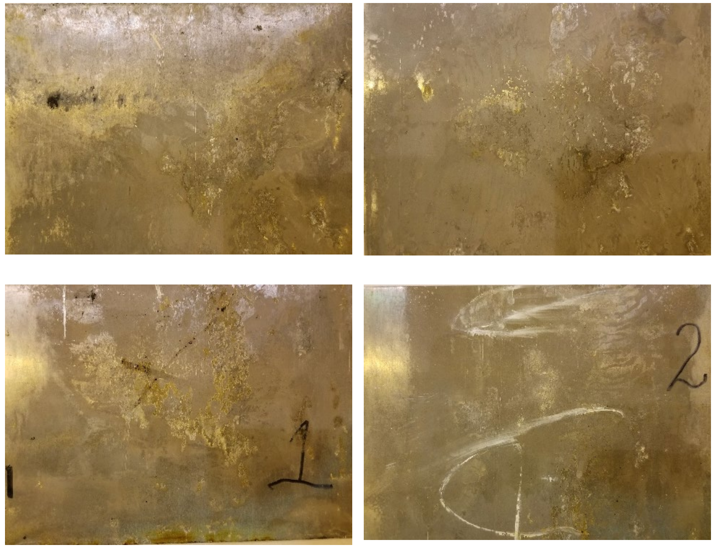
Panels to Coupons



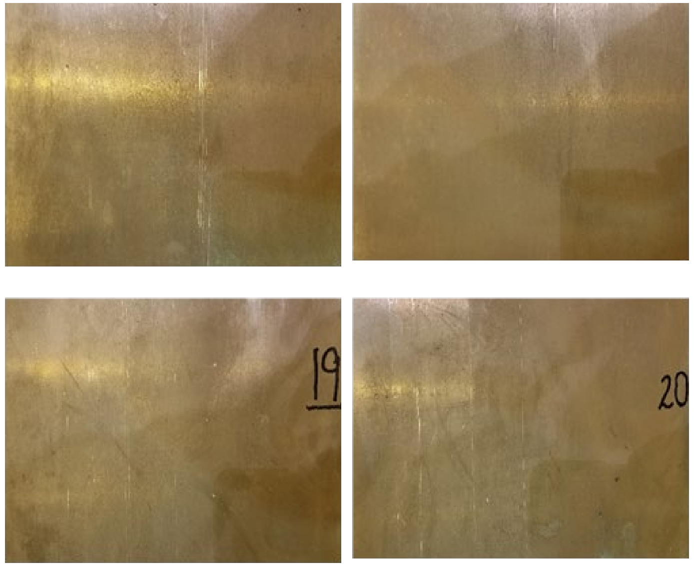
Panel 1 – Bottom segments



Panel 1 – Middle segments



Panel 2 – Bottom segments

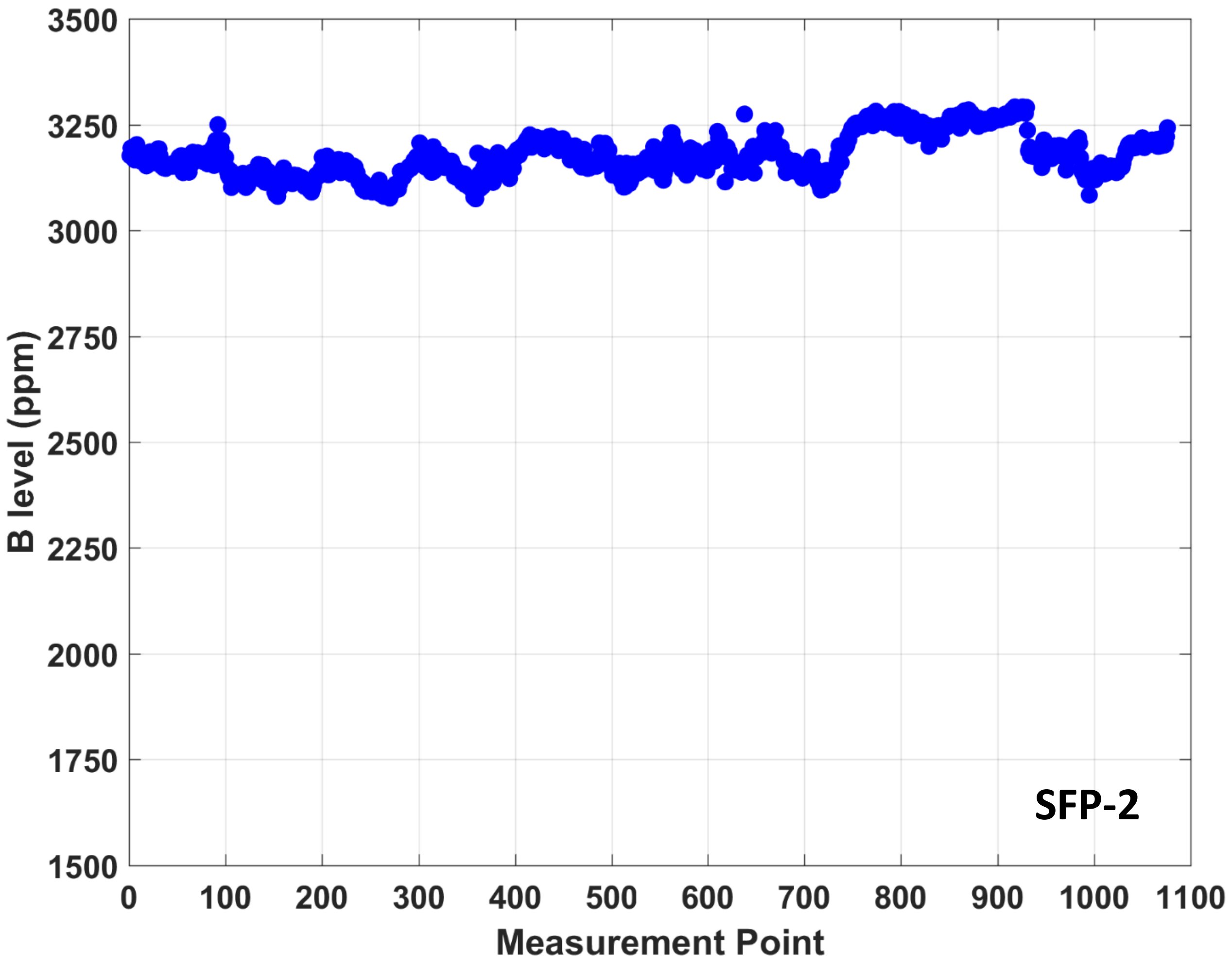


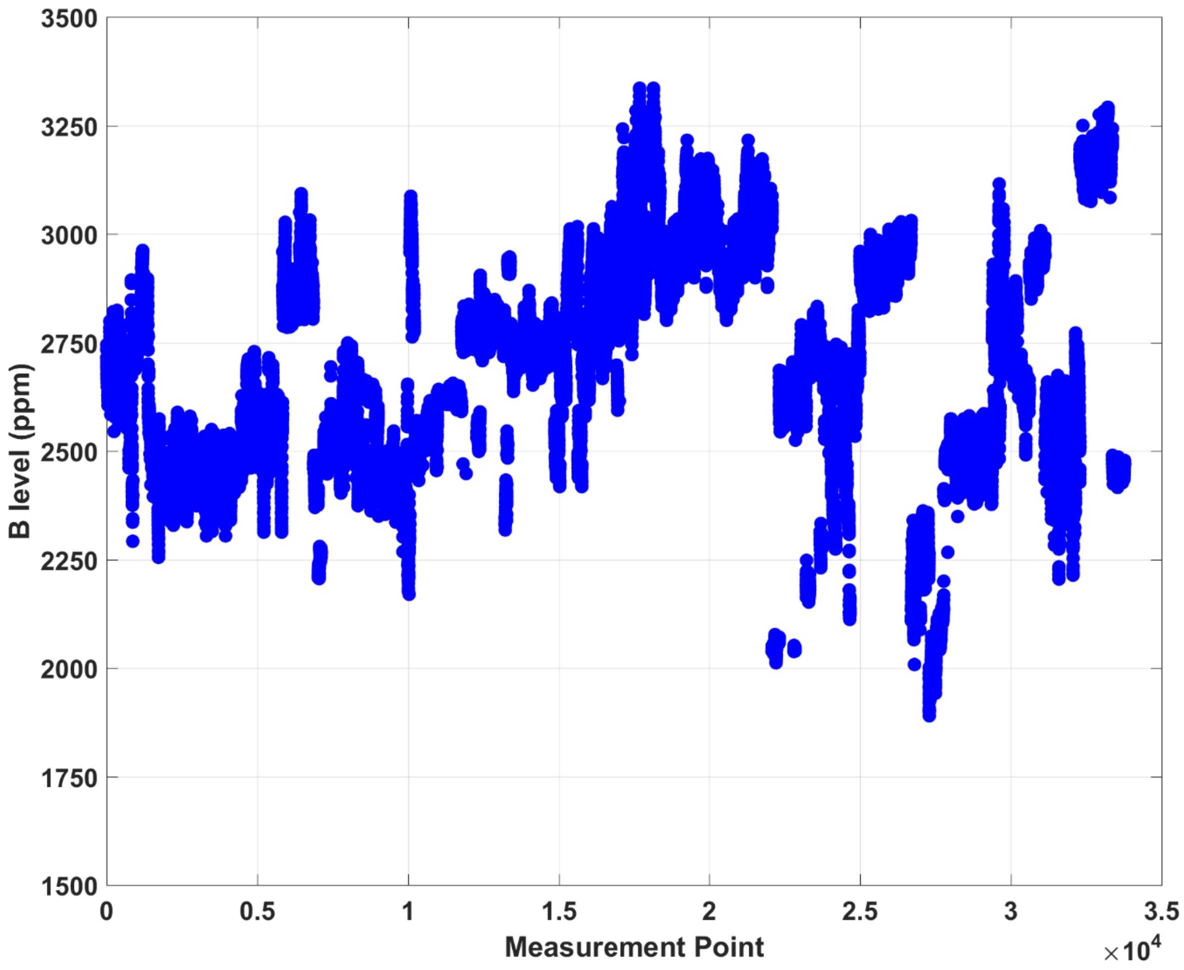
Panel 2 – Top segments

Panels are in very good condition

- **No blisters**
  - Despite being considered most susceptible to blisters due to age
- General flow patterns, scratches but no gross degradation

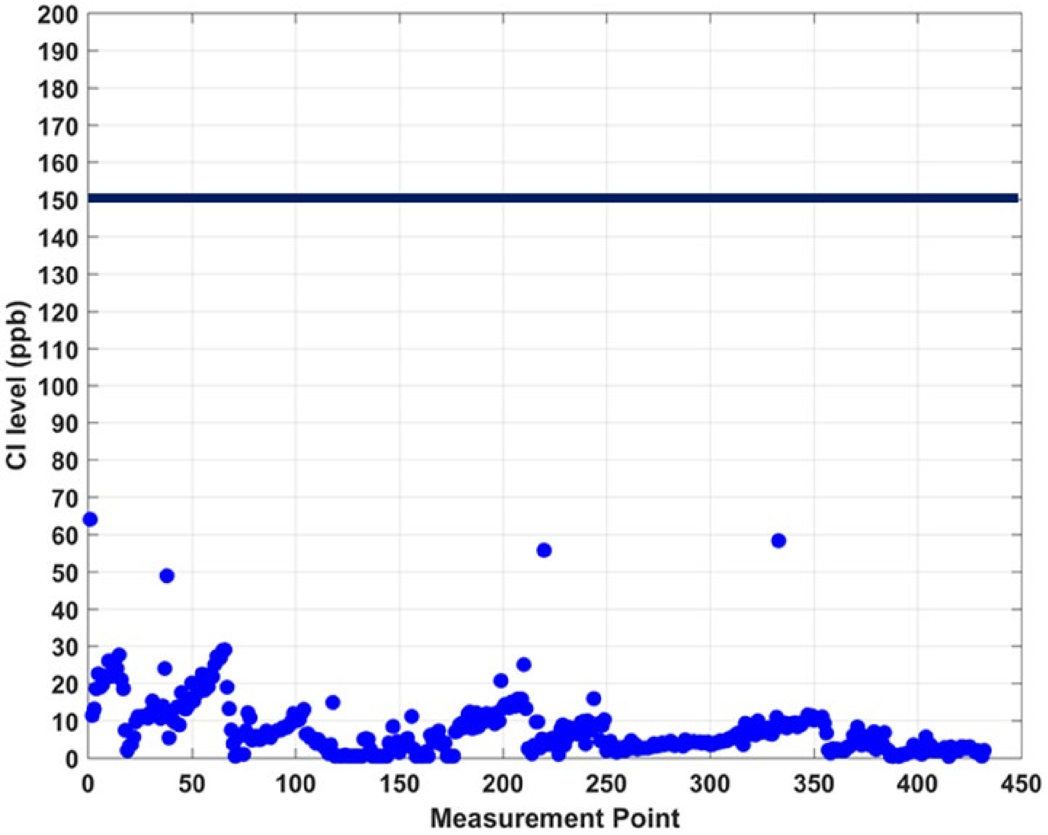
Water Chemistry: SFP-2 versus Industry Boron Levels

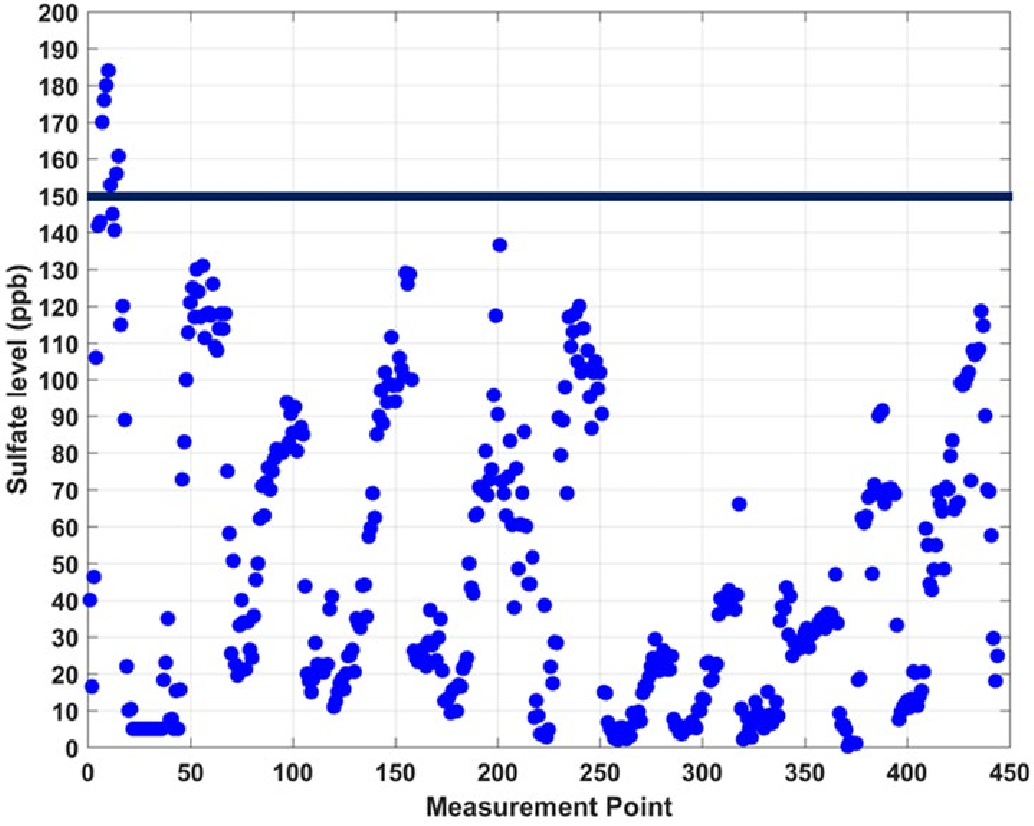




Relatively high Boron levels in SFP-2, compared to industry levels (shown on the right)

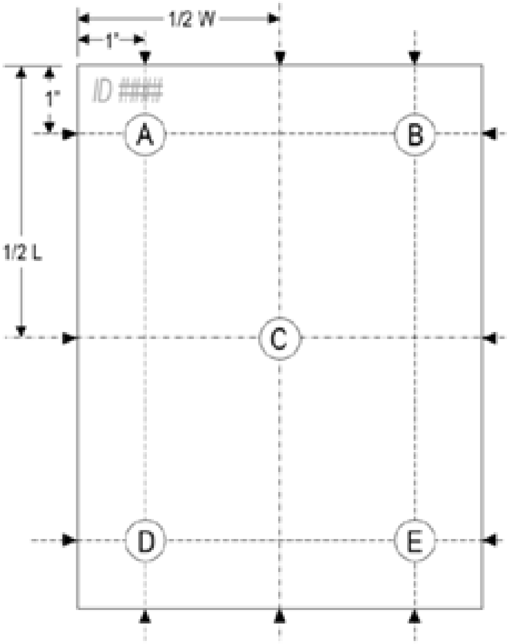
SFP-2 Water Chemistry – Cl and Sulfate Levels





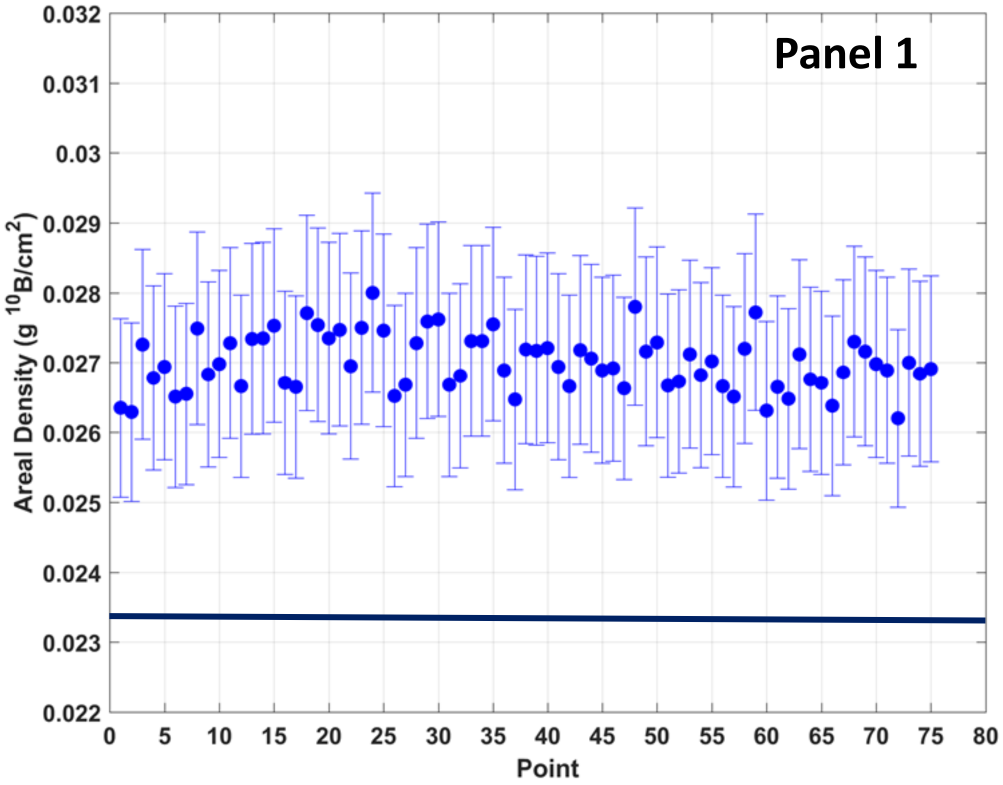
- Graphs show measurement data, from SFP-2, for ~20 years
- EPRI water chemistry guidelines recommend maintaining Cl, F, Sulfate levels below 150 ppb to minimize corrosion
- Cl levels well below 150 ppb
- Sulfate levels mostly within recommended values (<150 ppb)
- F levels, not shown but <10 ppb for the same time period

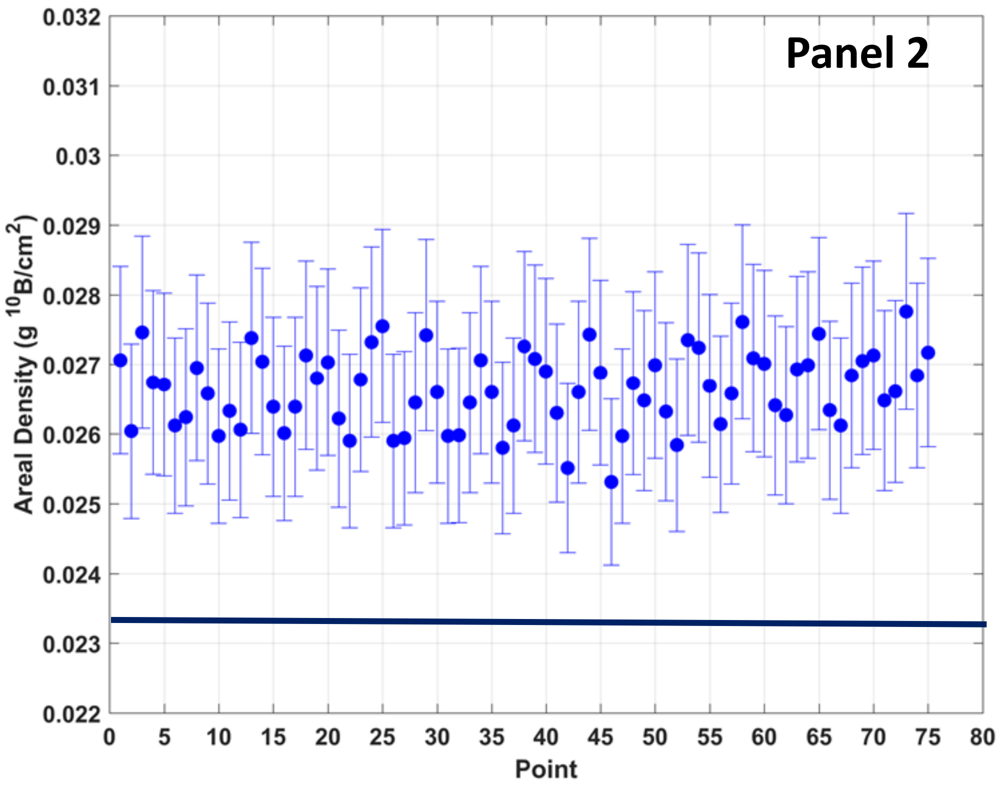
Areal Density Values for Samples from Panel-1 and Panel-2



For each sample, AD measurements performed at 5 locations

Areal Density Values for 15 Samples - 5 Points/Sample





Error bars represent 2σ values

- **Minimum Certified Areal Density (AD): 0.0233 g^{10}B/cm^2**
- **All the measured AD values above minimum certified AD values**

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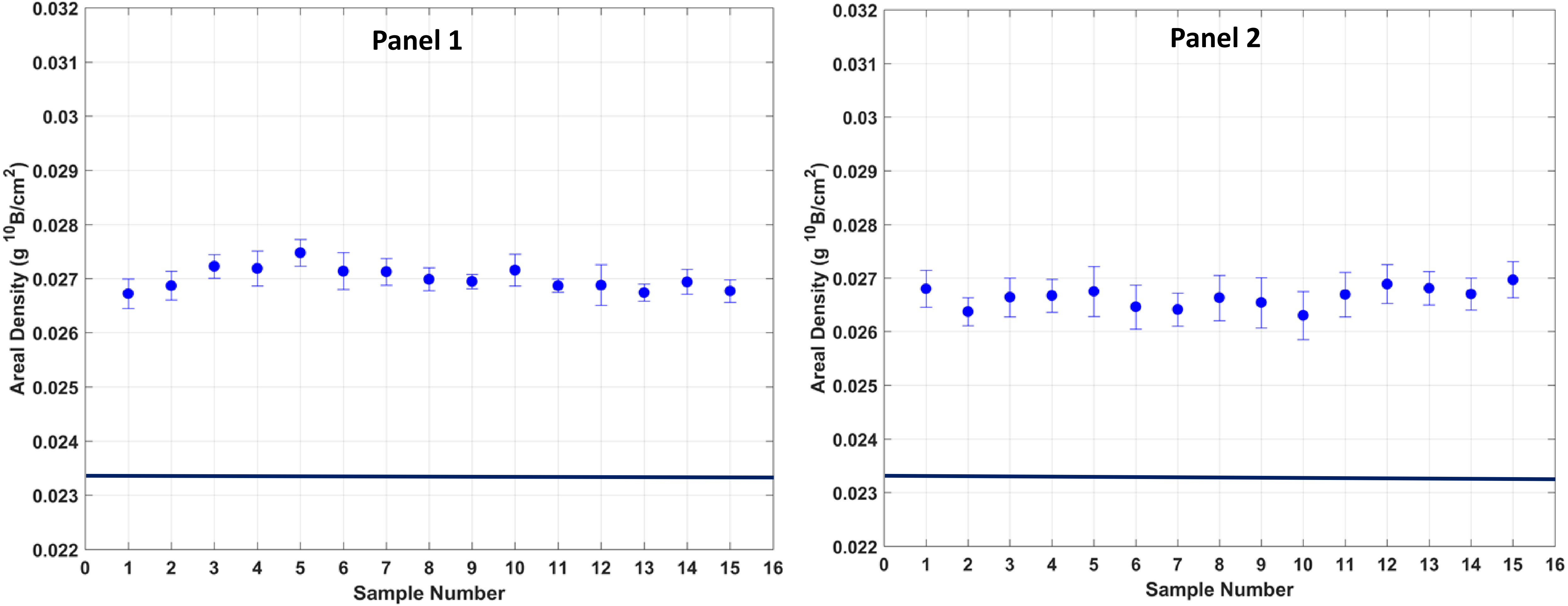
Average Areal Density Values: Average of 5 points/Sample



Error bars represent 2σ values

- Minimum Certified Areal Density (AD): 0.0233 $g^{10}B/cm^2$
  - All the measured AD values above minimum certified AD values
- No trend in AD as a function of axial height

Comparison of Panels from Zion SFP vs. SFP-2

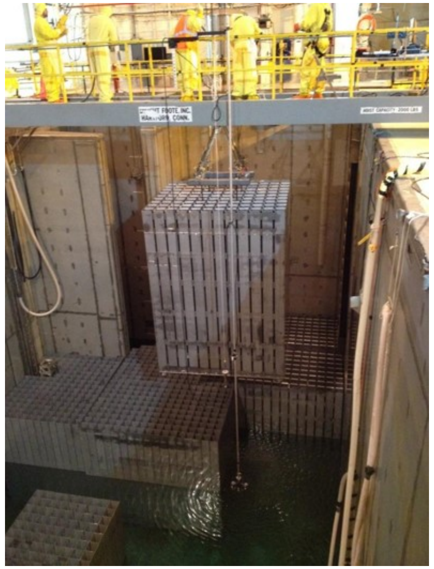
	Zion Region 1	Zion Region 2	SFP-2
Installation Year	1994	1994	1997*
Service time (years)	~20	~20	~40**
# of panels removed	8	6	2
Blisters	1***	N	N
Gross Degradation	N	N	N
Thickness (in.)	0.101	0.085	0.085
Min. Cert. AD ($g\ ^{10}B/cm^2$)	0.03	0.023	0.023

*Panels had previous history, in SFP-1, as shown in Slide 12
**Wet storage time, does not include dry storage time in between SFPs
***Only one panel showed a very small blister at the corner

Panels removed from Zion and SFP-2 were in very good condition: General flow patterns, scratches but no gross degradation

Example samples from Zion panels

Example sample from SFP-2 panels



Zion Module being removed from pool

Panel being removed from SFP-2

SFP-2 Updated Status

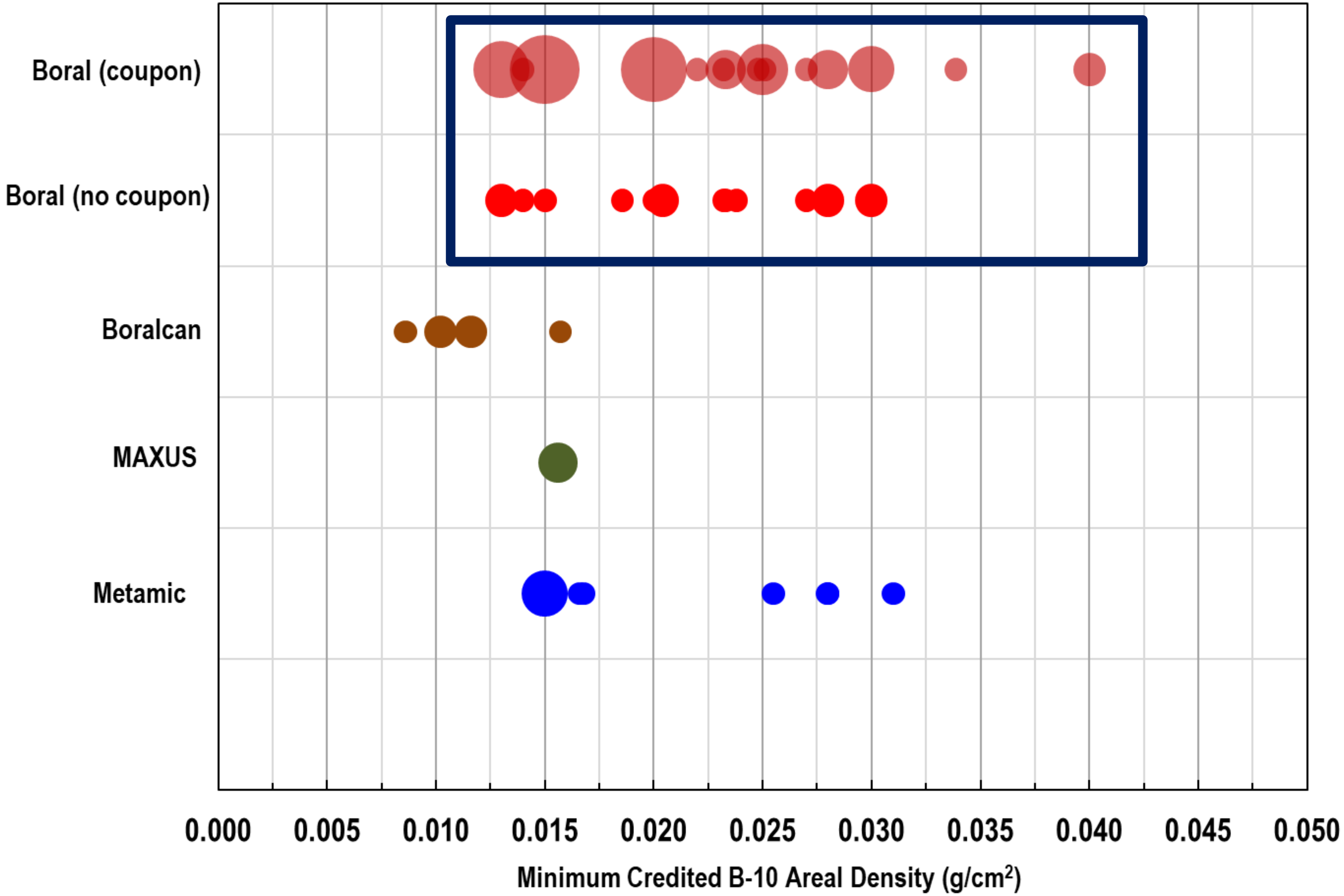
- Removed two panels from in-service racks to create coupons
- Developed aging management program based on coupon monitoring
- Built two coupon trees
- Placed coupons, representing both Panel-1 and Panel-2, in coupon trees
  - Did not place coupons in SS encapsulation
- Placed coupon trees in locations that enable accelerated exposure

Key outcomes:

1. One less SFP that does not have coupon monitoring program
2. Due to age and history, coupons from SFP-2 augment i-LAMP in a unique and valuable way – enable closing knowledge gaps
3. SFP-2 has 15 extra coupons for EPRI/industry use – currently not in the pool

Augmentation of i-LAMP Using Updated NAM Status & Non-US Data

Updated NAM Status in SFPs



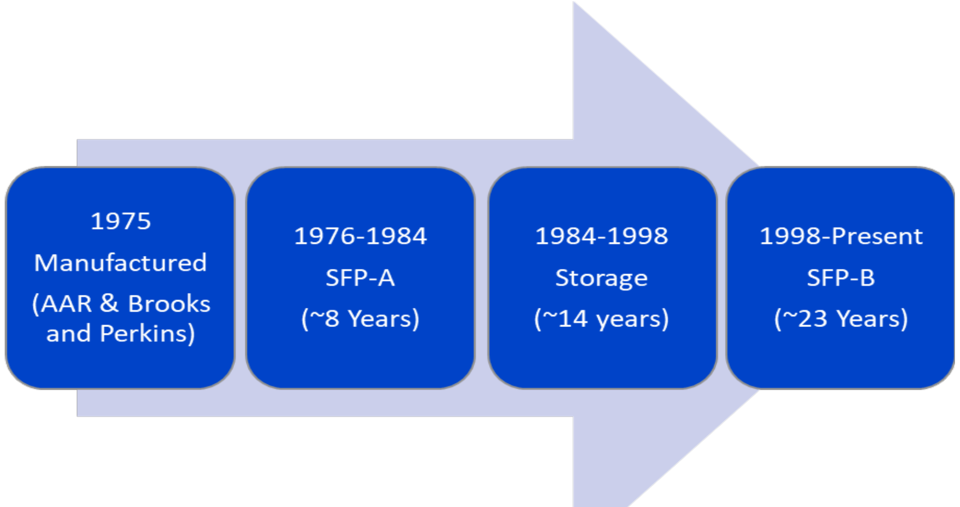
Boral

- 1 SFP from US moved from "No-Coupon" category to "Coupon" category
- 1 SFP from Europe added to "No-Coupon category"
- Added data from 2 SFPs, from North America (non-US), to "Coupon" category
- Added data from 8 SFPs, from Asia, to "Coupon" category

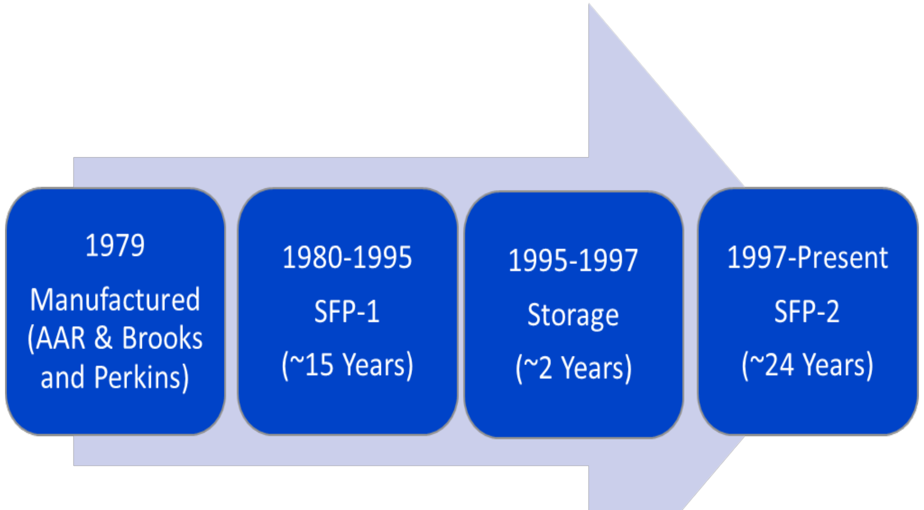
Metamic non-US SFPs are not added yet to the graph since current focus is on Boral – will be added

Pilot SFPs as Case Studies to Demonstrate Implementation of i-LAMP

Panel Histories: Pilot-1 (P-1) versus Sibling-1 (S-1)



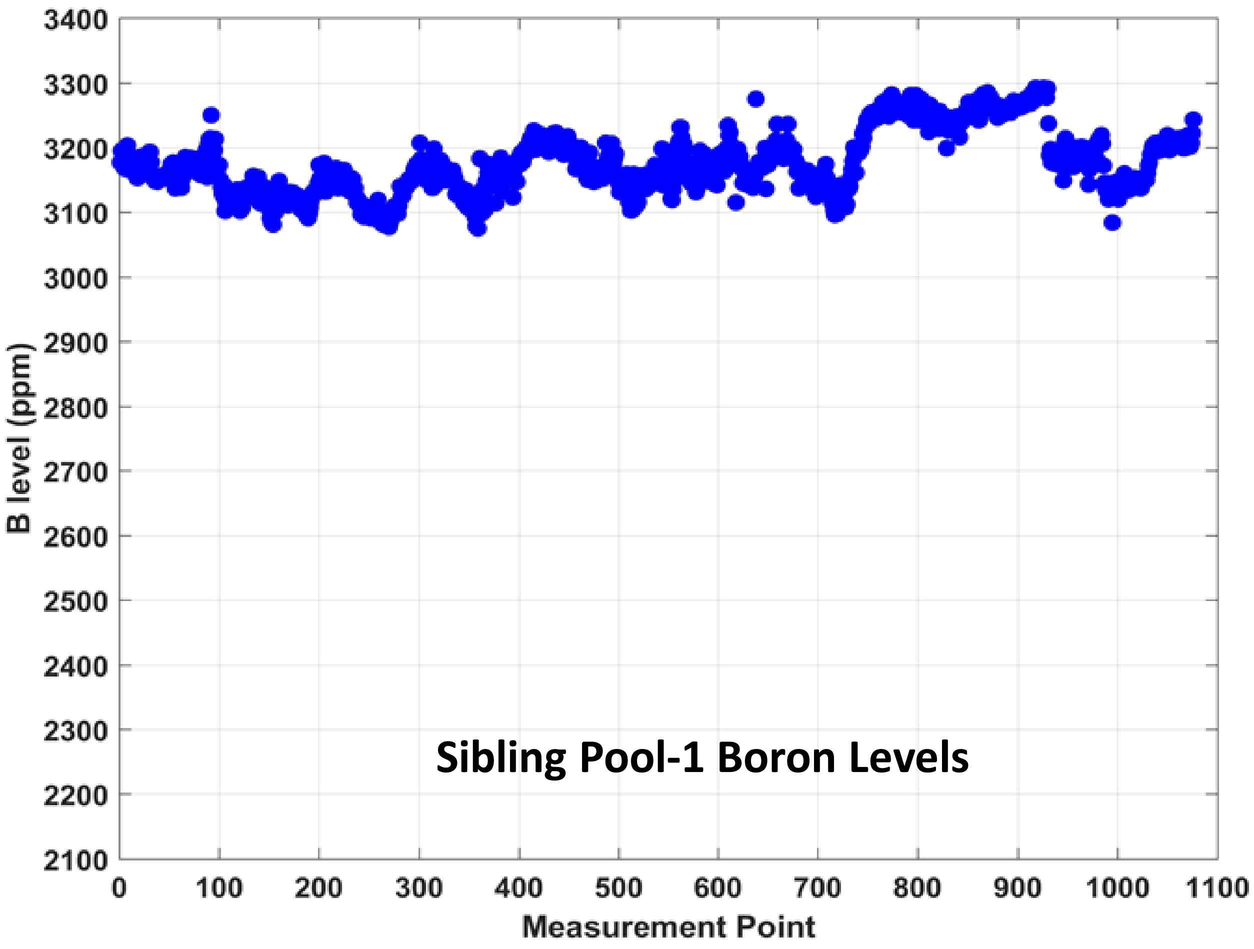
Pilot-1 (P-1) Panel History

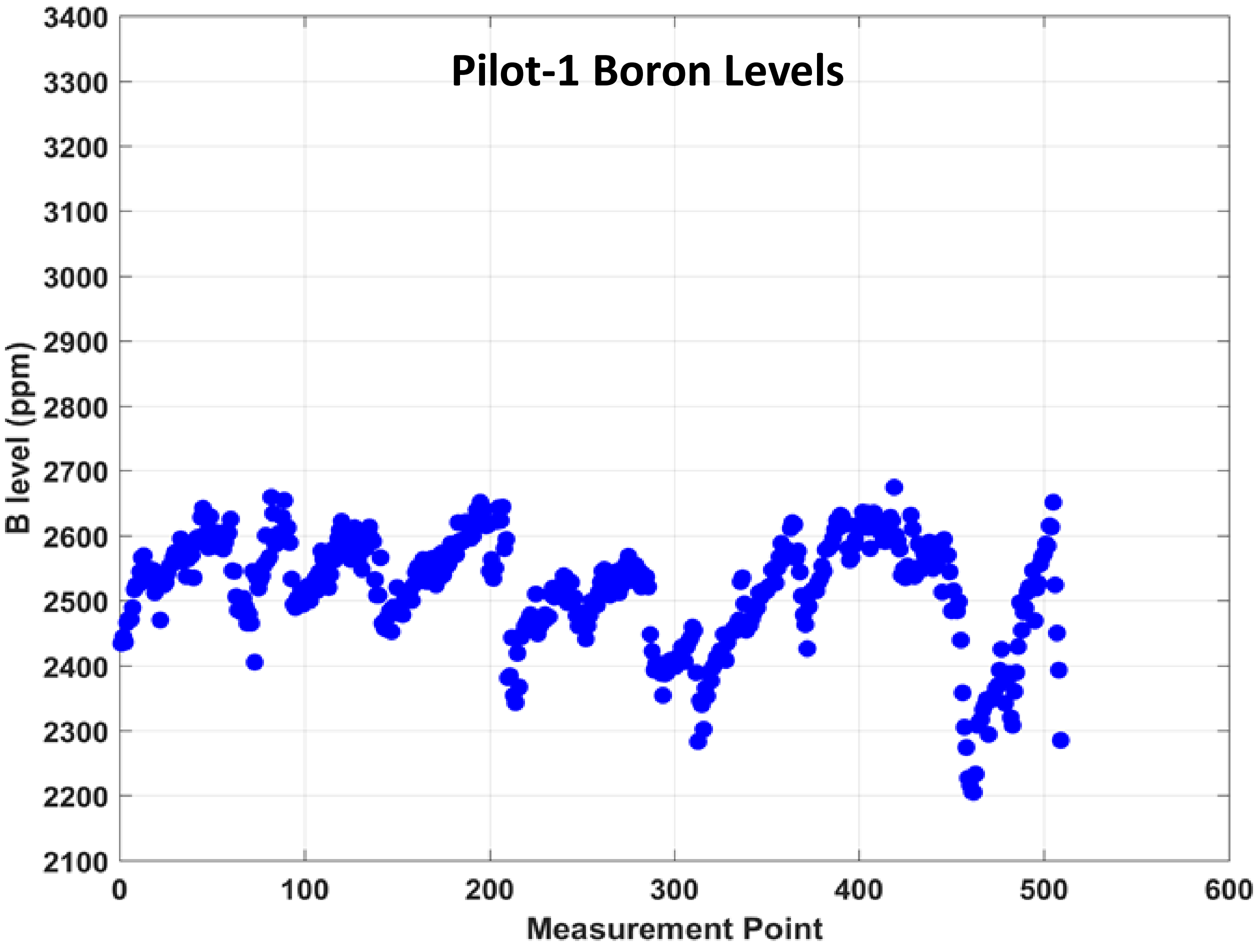


Sibling-1 (S-1) Panel History

- Unique panel history – very similar to panel history residing in SFP-2
  - Wet-Dry-Wet
  - Old Boral panels
- **Pilot-1:** ~30 years in-pool service history
- **Sibling-1:** ~40 years in-pool service history
  - One Boral type
- **Pilot-1:** Two boral types
  - Old Boral (reclaimed from SFP-A), installed in SFP-B in 1997
  - New Boral, installed in 1998
    - New Boral has higher AD but uses the same AD (lower value based on old Boral) in CSA

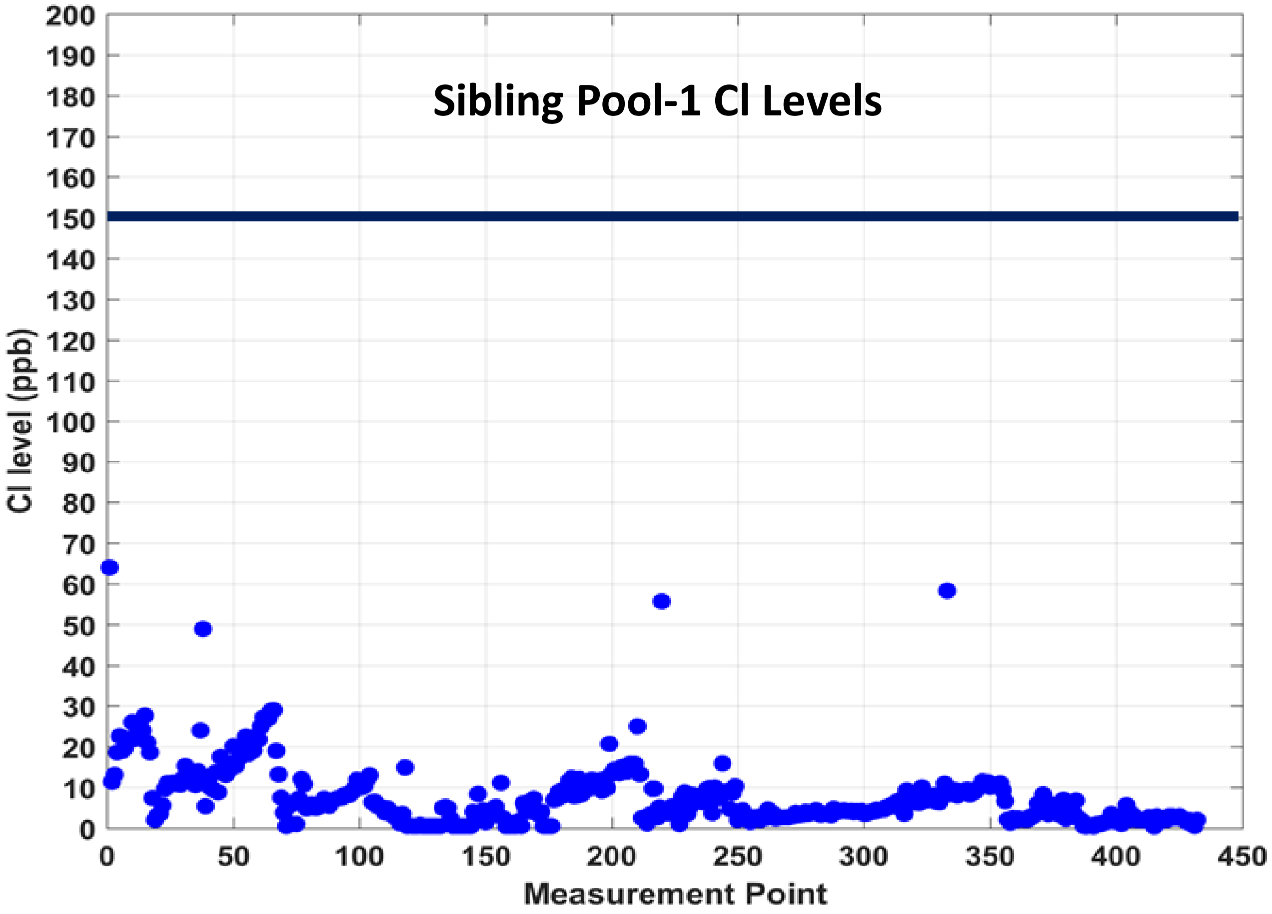
Water Chemistry for Sibling Pool-1 (S-1) versus Pilot-1 (P-1): Boron Levels

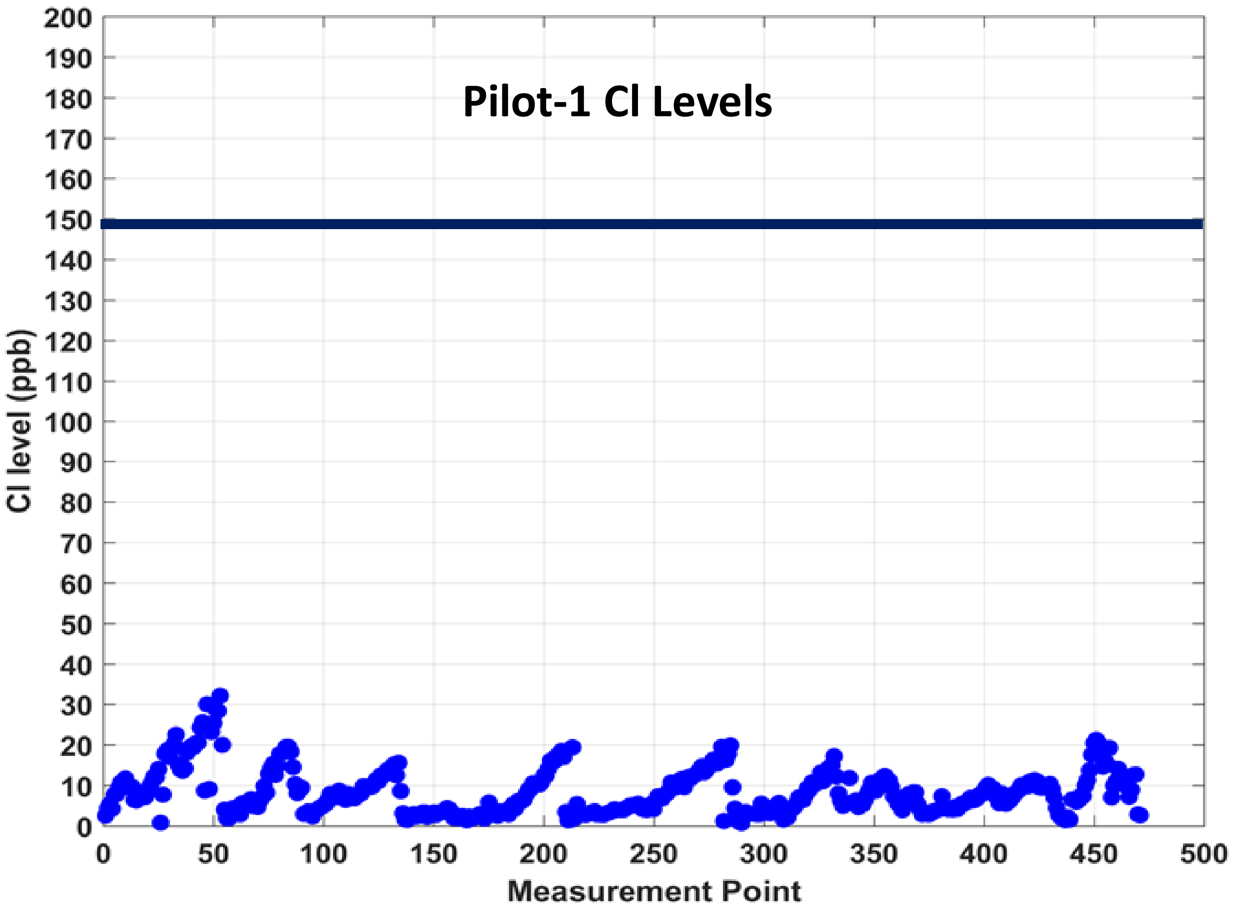




Pilot-1 Boron levels lower than Sibling Pool-1 Boron levels and more consistent with industry averages

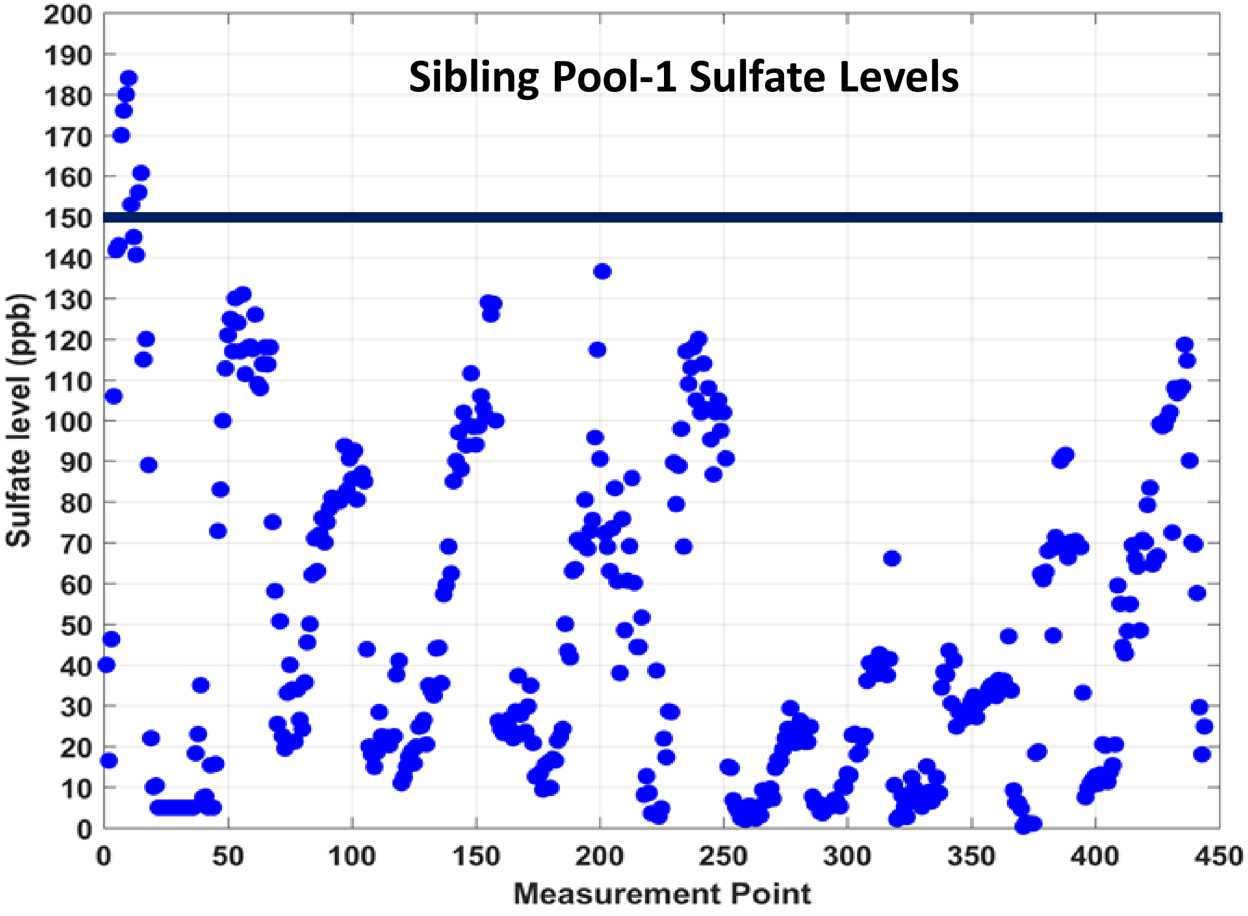
Water Chemistry for Sibling Pool-1 (S-1) versus Pilot-1 (P-1): Cl Levels

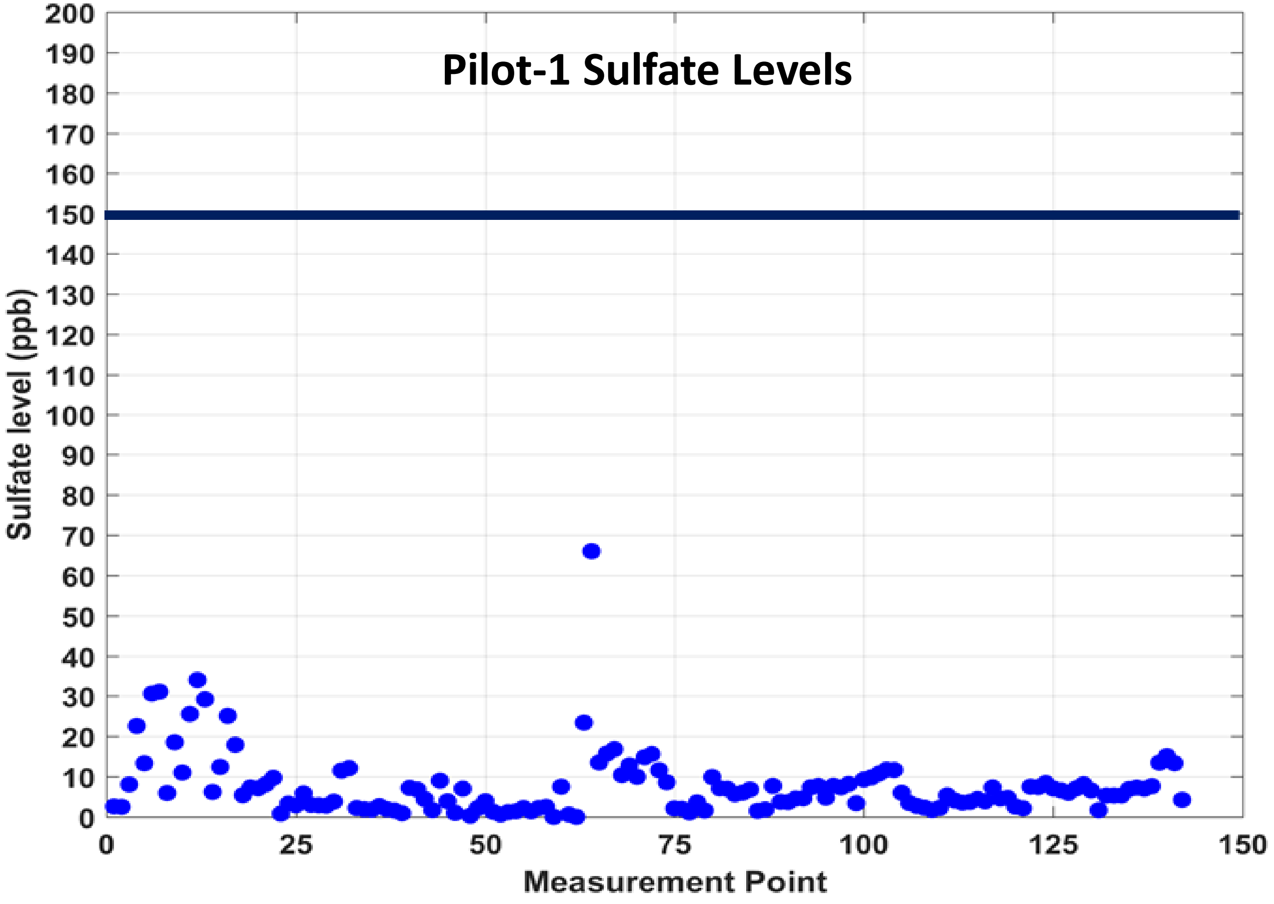




Cl levels for Pilot-1 and Sibling Pool-1 are well below recommended values (<150 ppb)

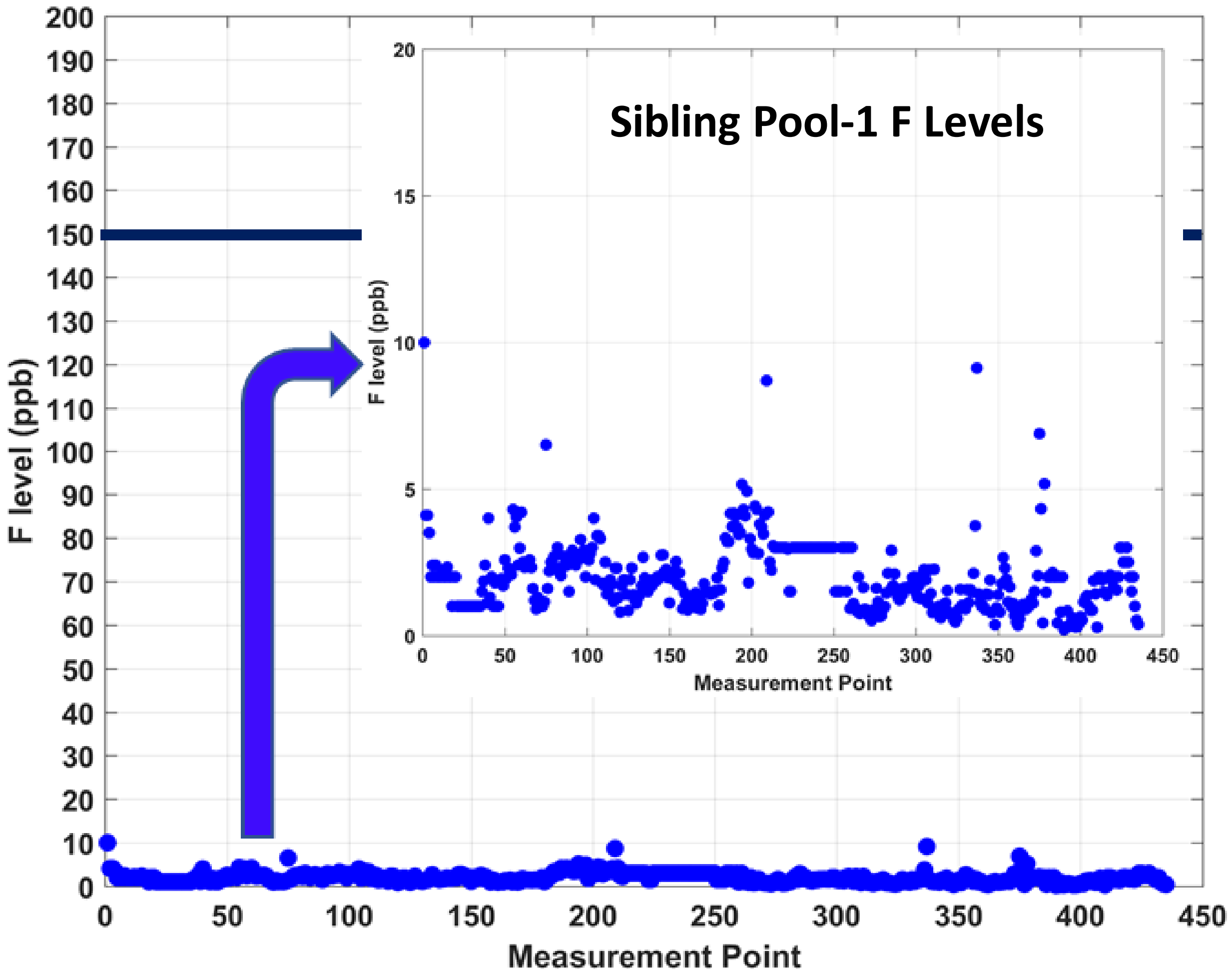
Water Chemistry for Sibling Pool-1 (S-1) versus Pilot-1 (P-1): Sulfate Levels

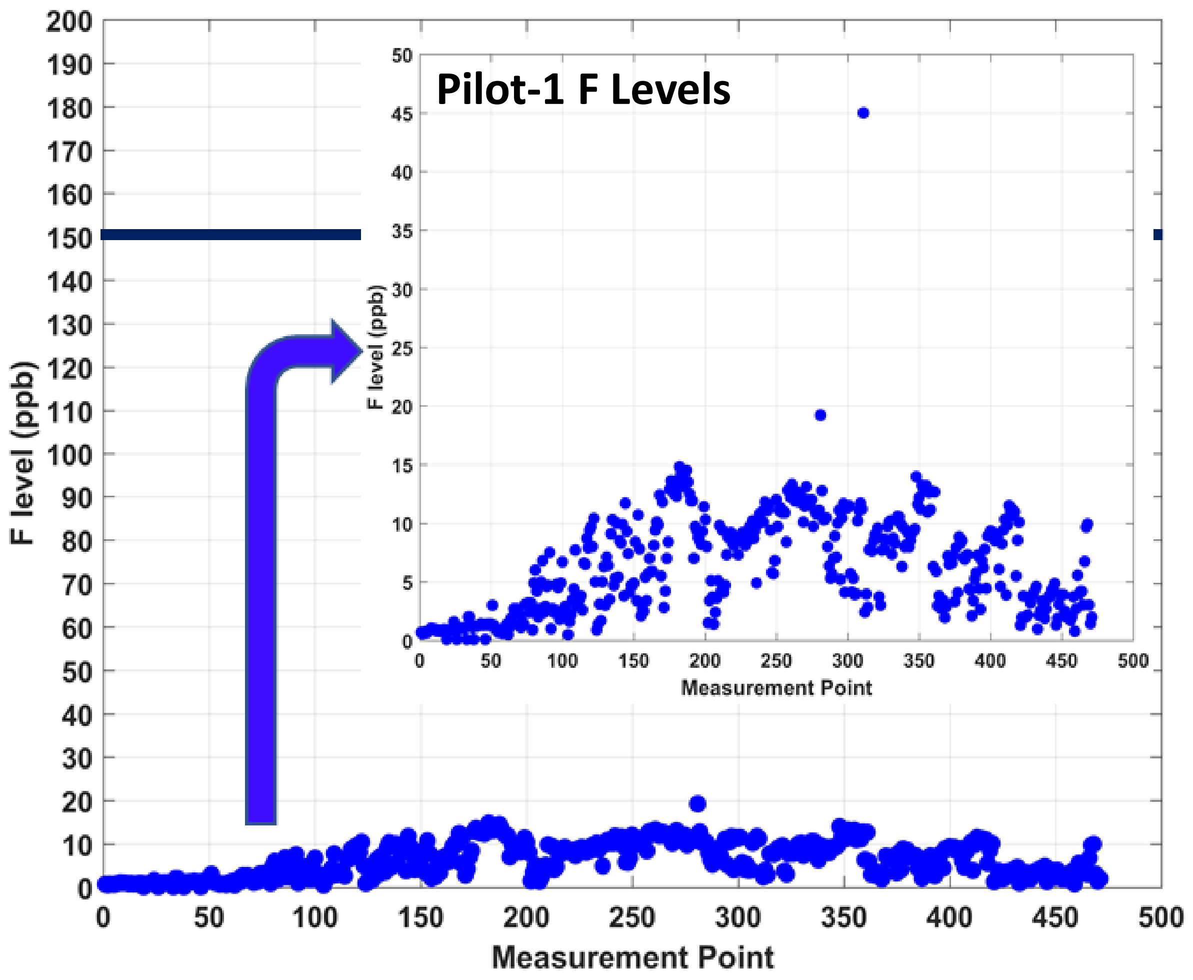




Cl levels for Pilot-1 and Sibling Pool-1 are well below recommended values (<150 ppb)

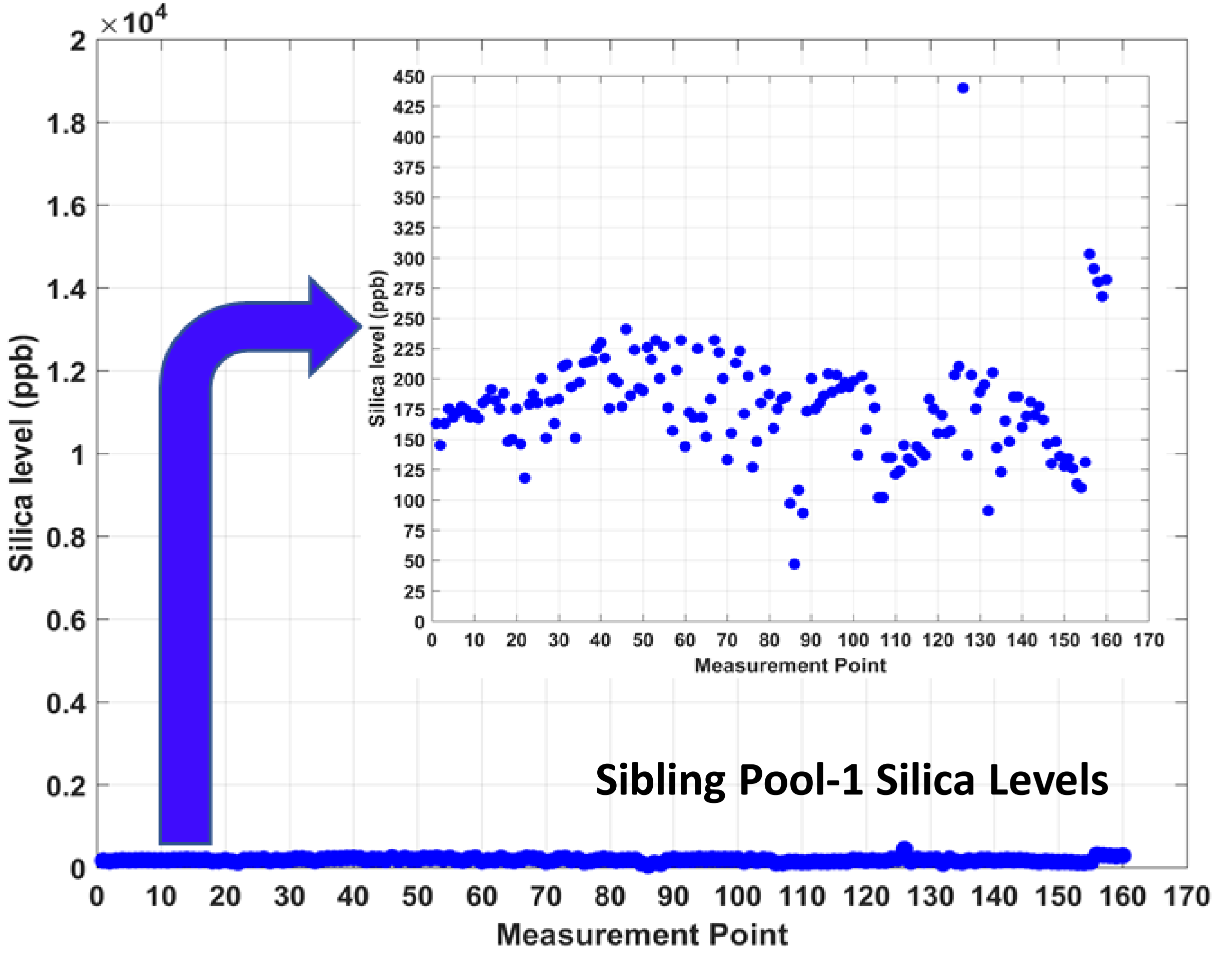
Water Chemistry for Sibling Pool-1 (S-1) versus Pilot-1 (P-1): F Levels

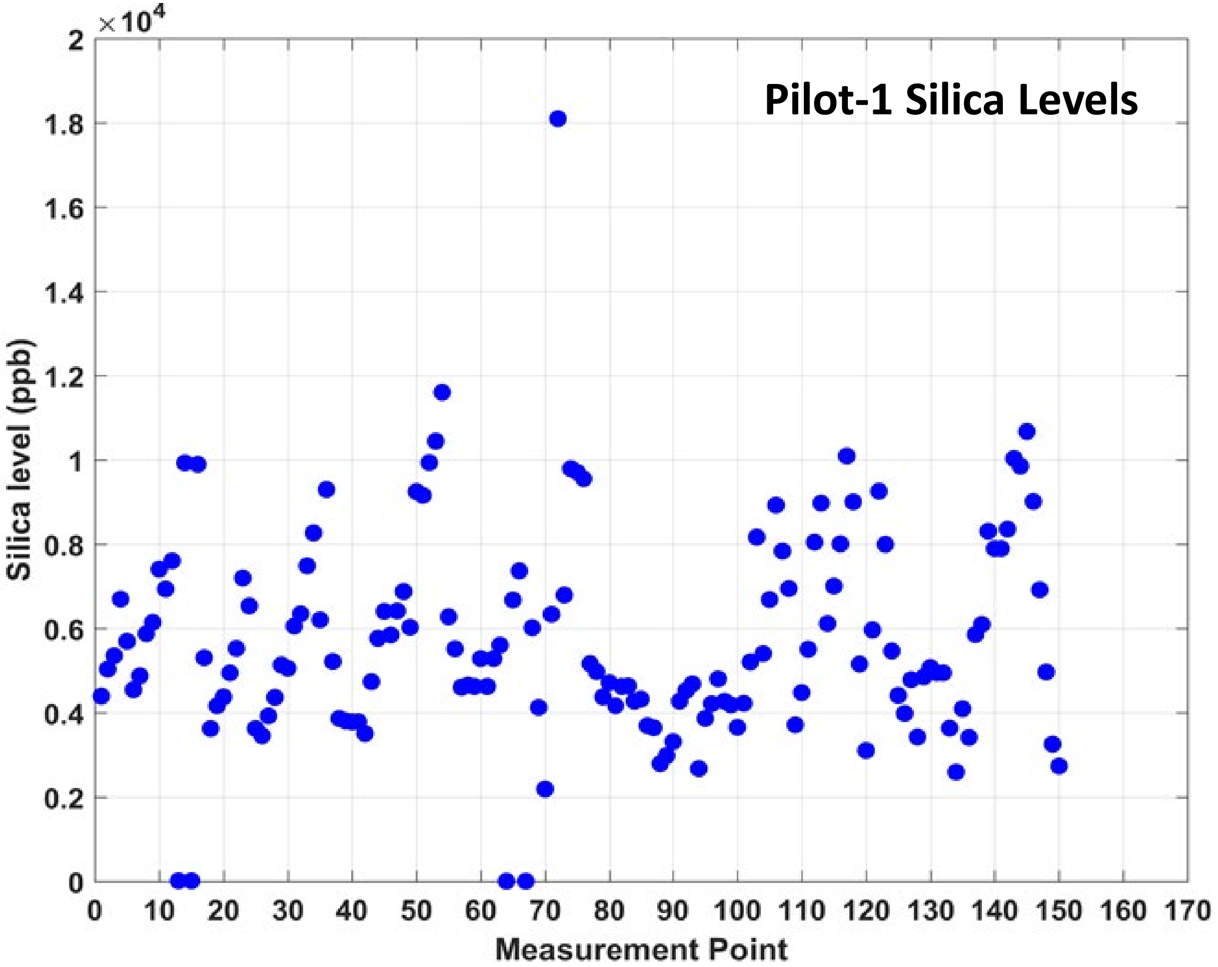




F levels for Pilot-1 and Sibling Pool-1 are well below recommended values (<150 ppb)

Water Chemistry for Sibling Pool-1 (S-1) versus Pilot-1 (P-1): Silica Levels

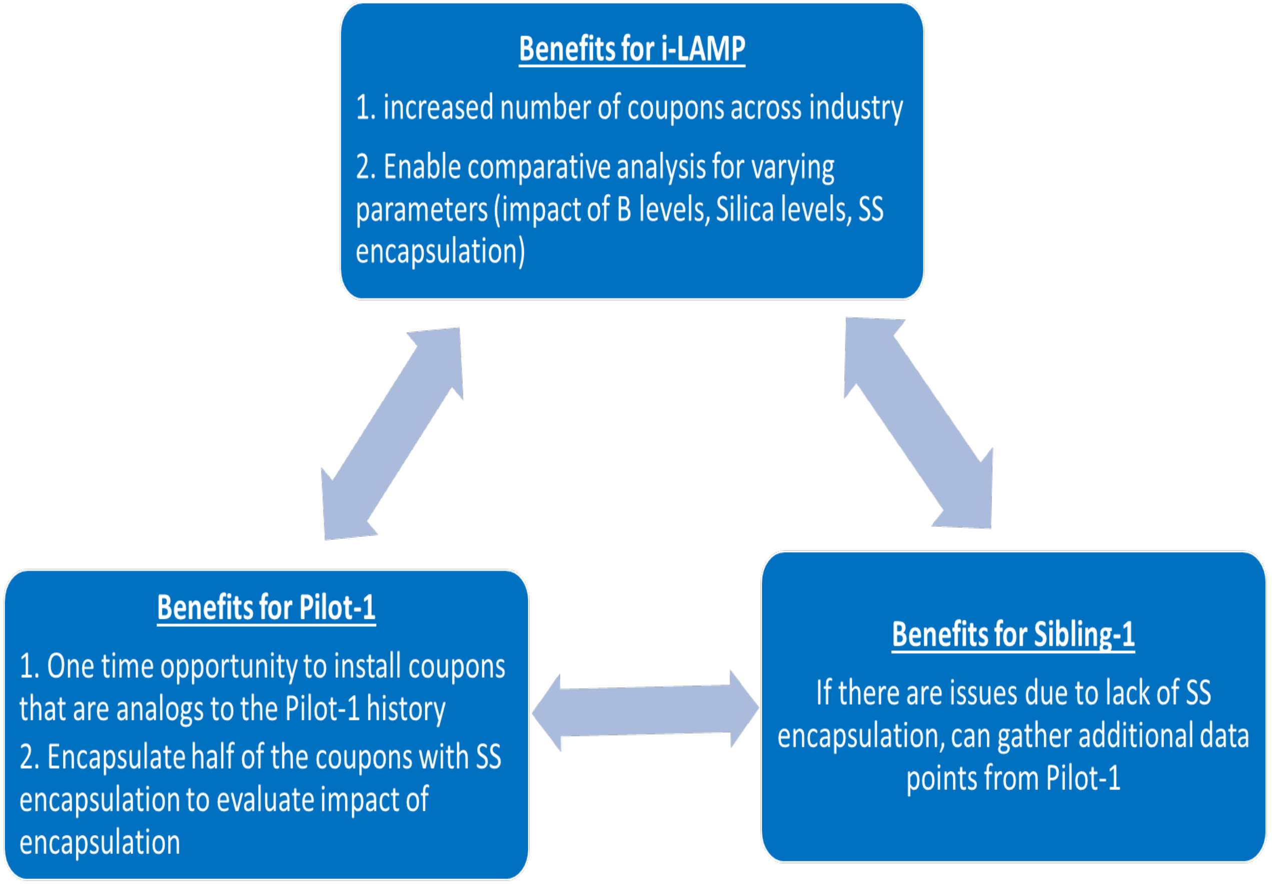




Significant differences between Pilot-1 and Sibling Pool-1 Silica levels

Proposed Path – Pilot-1

- Instead of simply proposing to use Sibling-1 as surrogate for Pilot-1, proposing:
    1. Take some of the remaining coupons from Sibling-1 and transfer to Pilot-1 pool
    2. Pilot-1 built a coupon tree
    3. Keep half of coupons bare and encapsulate half of the coupons
    4. Place them on coupon tree and install in Pilot-1 pool
    5. Develop an aging management program based on coupons
- This proposed approach has benefits for i-LAMP, Sibling-1, and Pilot-1
    1. One less SFP without coupon monitoring program
    2. Increased number of coupons across industry – beneficial for the health of i-LAMP
    3. Opportunity to evaluate impact of coupon size on formation of blisters in two SFPs
    4. Opportunity to evaluate impact of SS encapsulation versus bare coupons
    5. Opportunity to evaluate impact of higher Boron levels in Sibling-1 versus higher Silica levels in Pilot-1



Specifications for Pilot-1 new Boral, installed in 1998, are very similar to Pilot-2 Boral, described in next slides

Pilot – 2 versus Sibling: Description and Specifications

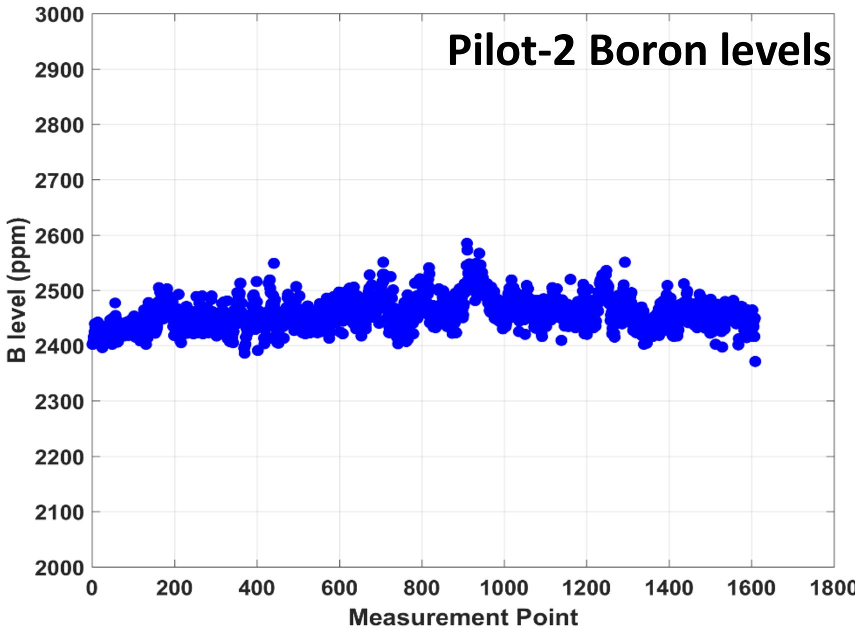
	Pilot-2*	Sibling-1	Sibling-2
Installation Year	1999	1993	2003
Thickness (in.)	0.101	0.101	0.101
Min. Cert. AD (g $^{10}B/cm^2$)	0.03	0.03	0.03
Coupons	N	Y**	Y***

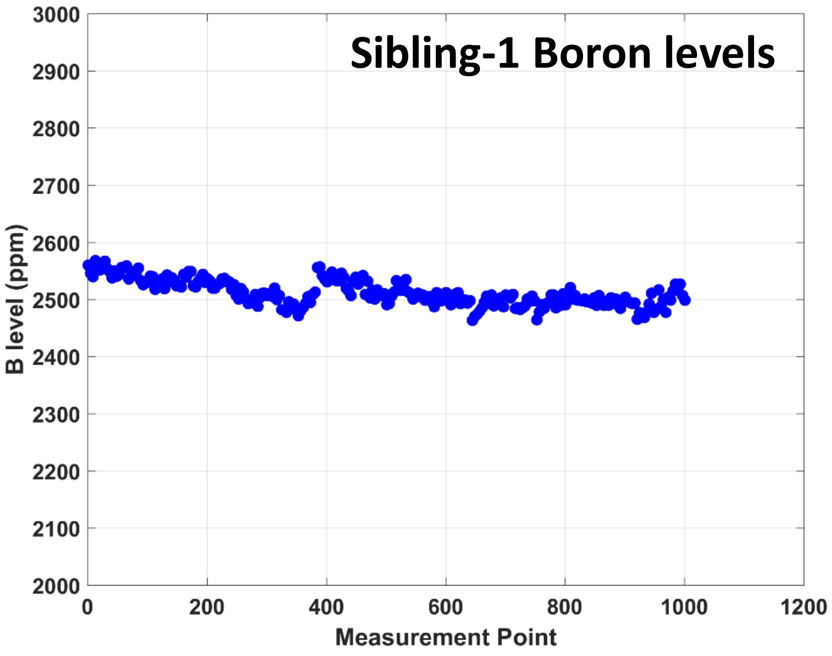
*Pilot-2 characteristics are very similar to Zion panels, installed in 1994, and Pilot-1 New Boral, installed in 1998.

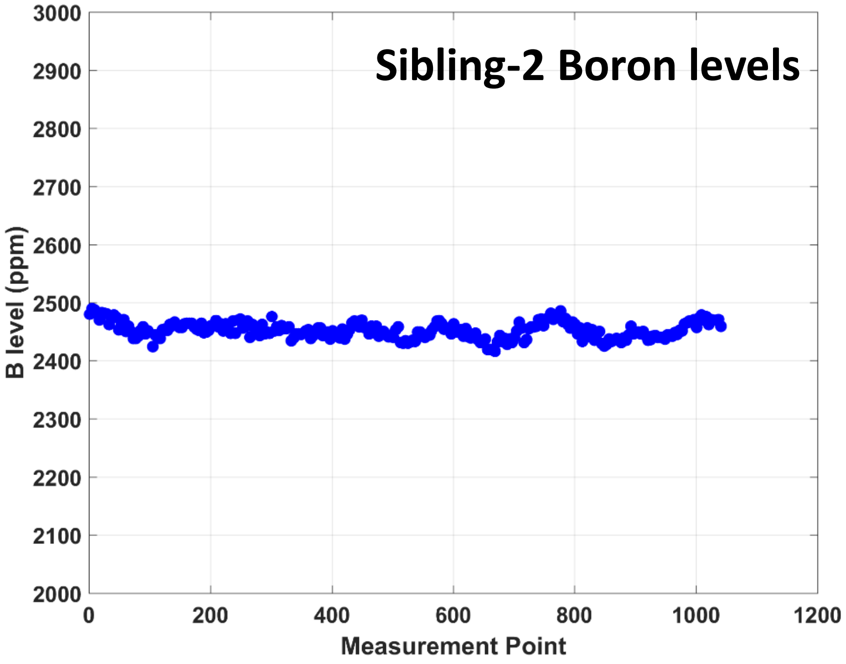
** No blisters. No gross degradation or decrease in areal density.

***Observed pitting, several blisters on some coupons. No gross degradation or decrease in areal density.

Pilot-2 versus Sibling Pool Water Chemistry – Boron Levels

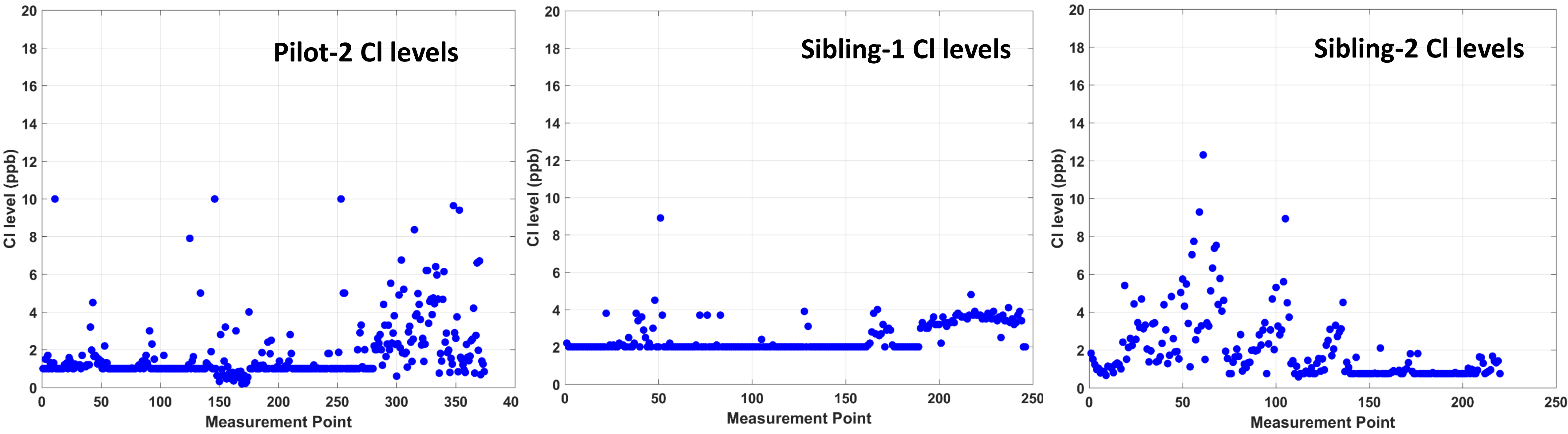






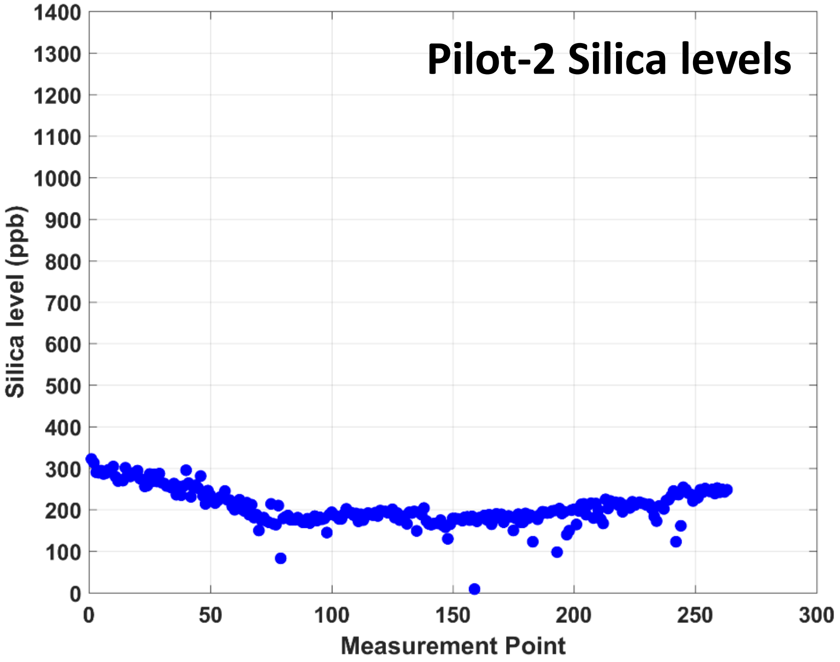
Boron levels for Pilot-2 and Sibling pools are very similar

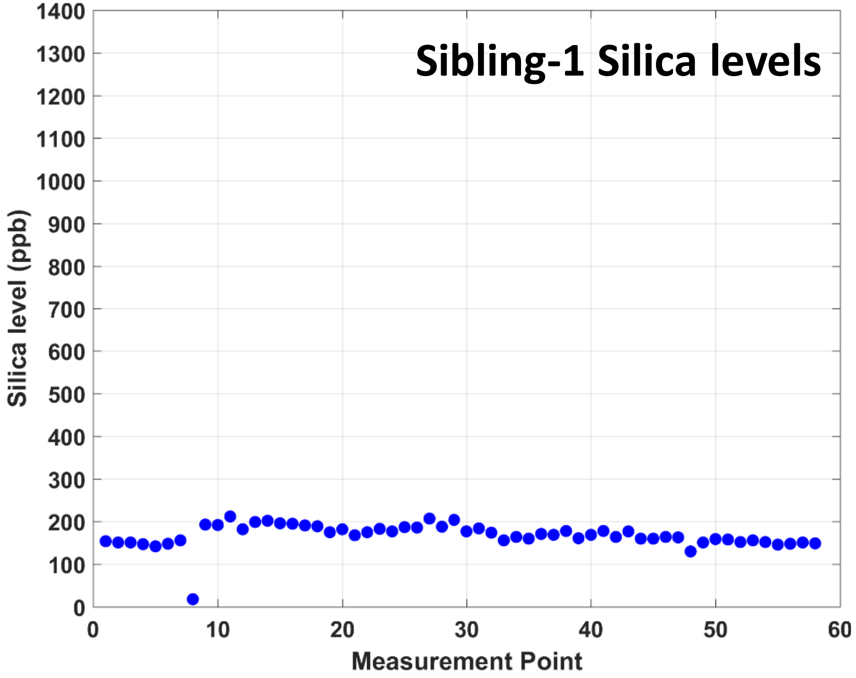
Pilot-2 versus Sibling Pool Water Chemistry – Cl Levels

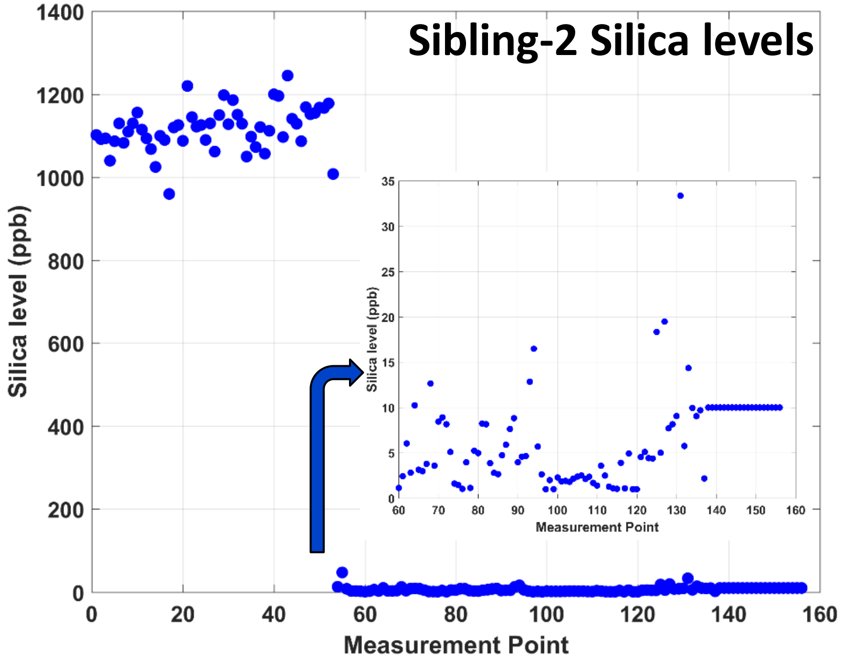


- Cl levels for Pilot-2 and Sibling pools are well below recommended values (<150 ppb)
- Although not shown, Sulfate and F levels for Pilot-2 and Sibling pools are very similar and well below recommended values (<150 ppb)

Pilot-2 versus Sibling Pool Water Chemistry – Silica Levels







Silica levels for Pilot-2 and Sibling-1 pool are similar; however, Sibling-2 has higher Silica levels early in the history

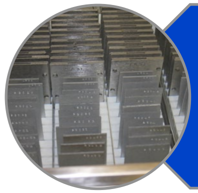
Proposed Path – Pilot-2

- Pilot-2, where panels were installed in 1999, is bounded by two siblings that has coupon monitoring program
  - Sibling-1 is older, installed in 1993
  - Sibling-2 panels were installed ~3 years after Pilot-1 panels
- Pilot-2 panels are also very similar to Zion panels
  - Older installation date (1994 installation for Zion panels) but the same thickness and minimum certified areal density)
- Water chemistry for Pilot-2 and Sibling pools are very similar except for early Silica levels for Sibling-2
- There are several other pools that do not have coupons but have very similar characteristics to Pilot-2; therefore, similar to Sibling-1 and Sibling-2

Pilot-2 can use Sibling-1 and Sibling-2 as surrogates

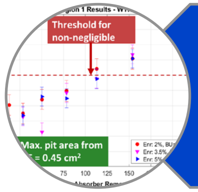
Summary & Proposed Path and Schedule

Summary: Toward a Global Industrywide Aging Management Program for NAMs*

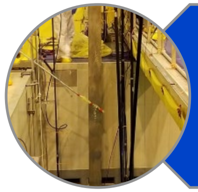


Laboratory: Accelerated Corrosion Test

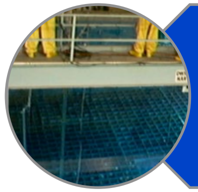
Actual panels, coupons, and in-situ measurements from SFP: Zion comparative analysis (3002008196 and 3002008195)



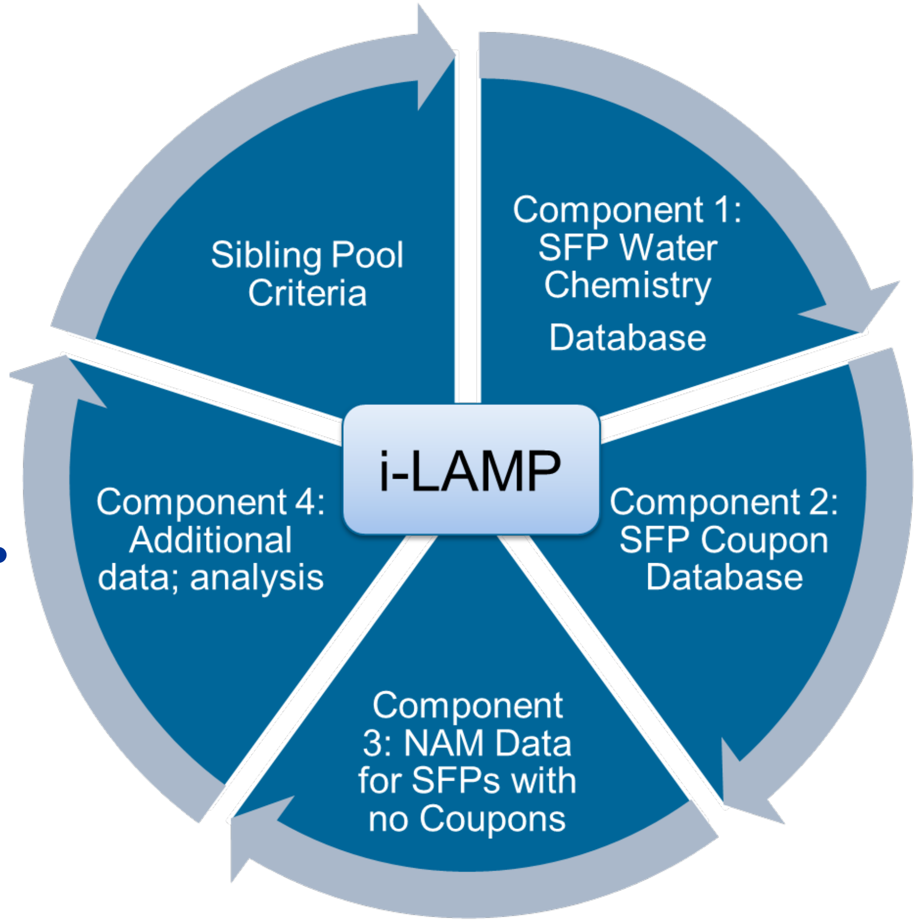
Modeling and Simulation: Evaluation of Impact of Blister and Pits (3002013119)



Evaluation of Panels from an Operating SFP



On-going collection of operating experience (SFP water chemistry, Coupon data)



i-LAMP: Industrywide NAM Learning Aging Management Program

*List of references included as backup material at the end

Initial Implementation of i-LAMP

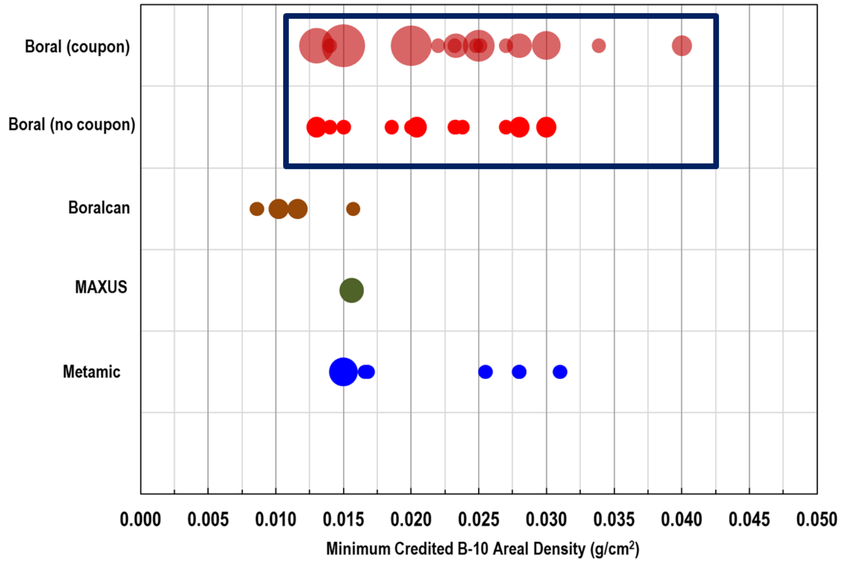
After all data analysis, for now, **proposing two bins**:

- **Bin 1** – SFPs with coupons
- **Bin 2** – SFPs without coupons

Commitment to i-LAMP and NEI 16-03 Rev. 1 for implementation

Why no need for binning in finer resolution, at this time? Key findings to date indicate:

- SFP water chemistry is maintained based on recommended values
    - Across the industry, Cl, F, Sulfate levels are mostly below 150 ppb
- Data and analysis to date does not indicate differences in degradation for PWR vs. BWR (Boron level effect)
- Accelerated corrosion test results showed that even for clad removed coupons, no statistically significant change in areal density
- Actual panels removed from two SFPs (Zion and SFP-2) do not indicate any significant degradation
    - This finding is especially significant for panels removed from SFP-2 due to unique history of the panels
- The size of the blistering or pitting observed to date has negligible impact on SFP criticality as demonstrated in EPRI report 3002013119



Based on the data we have to date, there is no safety significant issue for Boral aging management

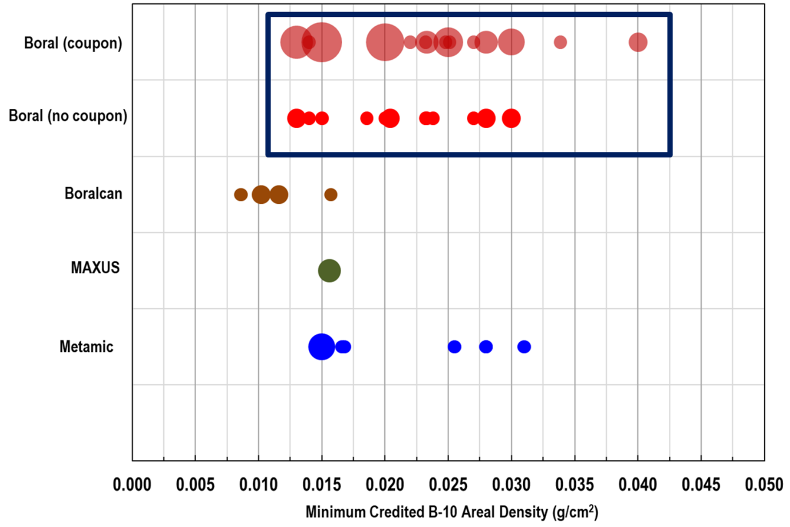
Initial Implementation of i-LAMP

After all data analysis, for now, **proposing two bins**:

- **Bin 1** – SFPs with coupons
- **Bin 2** – SFPs without coupons

Commitment to i-LAMP and NEI 16-03 Rev. 1 for implementation

- i-LAMP is a learning aging monitoring program.
- Data collection and analysis will continue, and number of bins will be refined, if/when needed.
- Updates will be provided to regulator on agreed upon intervals.



This approach will eliminate significant burden from industry and the NRC

In the future, if further binning is needed:

- Based on the data analysis, EPRI developed a table that summarizes sibling pool(s) for SFPs that do not have coupons
- EPRI can share this information with each utility that do not have coupon(s) and their corresponding sibling pool(s) and related supplemental information
  - NAM specifications – Areal densities, installation and manufacturing years, thicknesses
  - Water chemistries

SFPs w/o Coupon Monitoring Program	Sibling Pool(s)
SFP-A	S-1, S-2, S-3
SFP-B	S-1 & S-2
SFP-C & SFP-D	S-1
SFP-E, SFP-F, SFP-G	S-1 & S-2

Question:

Once NEI 16-03, Rev. 1 approved by the NRC, what regulatory interactions are required by the utilities?

Summary and Next Steps

Summary

- Collection and analysis of SFP data ongoing as these are live databases
- Addition of panel data from an operating SFP with unique history augmented i-LAMP significantly
- Demonstrated implementation of i-LAMP using two pilot plants as case studies
- Proposed an alternate solution for one of the pilot plants
  - Implementation of proposed approach, if approved by regulator, will improve i-LAMP and shed light on few remaining questions

Next Steps: i-LAMP as Alternate Monitoring Program

- Publication of EPRI technical report to summarize i-LAMP components, data and sibling pool criteria in late 2021
- NEI 16-03 is being revised to add i-LAMP as alternate monitoring approach
- Regulatory review for the proposed approach is the next step
- For non-US, anticipating several applications after NRC review and approval and EPRI will support non-US applications
- EPRI will continue to maintain i-LAMP, if approved, and provide regular with updates on agreed upon intervals

Proposed: NEI 16-03 Revision 1

A neutron absorber monitoring program may rely on a combination of the following approaches:

1. *Installation of a neutron absorber coupon tree with periodic removal and testing of neutron absorber coupons;*
2. *i-LAMP*
3. *In-situ measurements of the neutron absorbing capability of the installed neutron absorber panels,*

Add i-LAMP as alternate monitoring approach in NEI 16-03, Rev.1, provide brief description, and refer to EPRI report for details of i-LAMP

EPRI i-LAMP Report Outline - DRAFT

1. INTRODUCTION

2. BACKGROUND

2.1 Generic Letter Issuance

2.2 NEI 16-03: Guidance for Monitoring of Fixed Neutron Absorbers in SFPs

2.3 i-LAMP Proposal

2.4 Generic Letter Closure

2.4.1 Status of NAMs Based on Generic Letter Responses

3. i-LAMP DEVELOPMENT

3.1 Overview of Neutron Absorber Materials and Monitoring Status in i-LAMP

3.2 SFP Water Chemistry

3.3 SFP Coupon Database

3.4 SFPs with No Coupons

3.5 NAM Condition and Synergy Effects

3.5.1 Impact of age and service time

3.5.2 PWR vs. BWR

3.5.2 Impact of Silica levels

3.5.3 Impact of Cl levels

3.5.4 Impact of Sulfate levels

3.6 Sibling Pool Criteria

4. AUGMENTATION AND BOUNDING OF I-LAMP VIA EVALUATION OF PANELS FROM AN OPERATING SPENT FUEL POOL

4.1 History of Panels

4.2 Removal of Panels

4.3 Water Chemistry History

4.4 Areal Density Values

4.4.1 Sample Identification and Areal Density Measurement Locations

4.4.2 Areal Density Values for Panel 1

4.4.3 Areal Density Values for Panel 2

4.5 Comparison of Panels from Zion and SFP1

4.5.1 Blistering and Potential Coupon Size Effect

4.6 Bounding of i-LAMP for Boral via SFP1

EPRI i-LAMP Report Outline - DRAFT

5. PILOT PLANTS AS CASE STUDIES FOR I-LAMP

5.1 Description of Pilot Plant 1

5.1.1 History of Pilot Plant 1 and Comparison to SFP1

5.1.2 NAM Specifications for Pilot Plant 1 and Comparison to SFP1

5.1.3 Water Chemistry for Pilot Plant 1 and Comparison to SFP1

5.1.4 Benefits of Proposed Approach for Pilot Plant 1 and i-LAMP

5.2 Description of Pilot Plant 2

5.1.1 History of Pilot Plant 2 and Surrogate SFPs

5.1.2 NAM Specifications for Pilot Plant 2 and Surrogate SFPs

5.1.3 Water Chemistry for Pilot Plant 1 and Surrogate SFPs

6. PROPOSED IMPLEMENTATION OF I-LAMP AND PATH FORWARD

6.1 NEI 16-03 revisions

6.2 Proposed Updates and Frequency

7. SUMMARY AND CONCLUSIONS

8. REFERENCES

APPENDIX A: Panel Pictures for Panels from SFP1

APPENDIX B: Areal Density Values for Panels from SFP1

Schedule & Milestones

May-July 2021

- Fee waiver request letter submitted – May 13, 2021
- Fee waiver request approved, June 22, 2021
- Pre-application meeting – July 7, 2021
  - Summary of i-LAMP, introduction of pilot plants

Sept-Oct. 2021

- TBD - If desired, NRC meeting(s) prior to submission of the EPRI report and revised NEI 16-03
- October, submission of EPRI report along with NEI 16-03 Rev. 1 for the NRC review

TBD

- NRC review process

Together…Shaping the Future of Electricity

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2. *Evaluation and Selection of Neutron Absorber Panels for the Zion Comparative Analysis Project.* EPRI, Palo Alto, CA:2017. 3002010611.
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5. H. Akkurt, M. Harris, A. Quigley, "*Evaluation of Neutron Absorber Panels from Zion Spent Fuel Pool*," Transactions of the American Nuclear Society. 115, 645–647 (2016).
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2. H. Akkurt, A. Quigley, and M. Harris, "*Accelerated Corrosion Tests to Evaluate the Long-Term Performance of BORAL® in Spent Fuel Pools*," Proceedings of PATRAM 2019 Conference, New Orleans, LA, August 2019.
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1. *Evaluation of the Impact of Neutron Absorber Material Blistering and Pitting on Spent Fuel Pool Reactivity*, EPRI, Palo Alto, CA: 2018. 3002013119.
2. H. Akkurt, M. Wenner, A. Blanco, "*Evaluation of the Impact of Neutron Absorber Material Blistering and Pitting on Spent Fuel Pool Reactivity*," Proceedings of International Criticality Safety Conference (ICNC 2019), Paris, France, September 2019.

Overview

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2. H. Akkurt, K. Cummings, "*Overview of Neutron Absorber Materials Used in Spent Fuel Pools*," Proc. of International Criticality Nuclear Safety Conference (ICNC 2015), Charlotte, NC, September 2015.

i-LAMP

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2. H. Akkurt and E. Wong, "*Industrywide Global Efforts Toward Long Term Monitoring of Neutron Absorber Materials in Spent Fuel Pools*," Proceedings of IAEA Spent Fuel Management Conference, Vienna, Austria, June 2019.
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